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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Offices: Investment Bldg., Washington, D. C.

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American Potash Institute, Inc.
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THE MARCH LION

Better Crops with PLANT FOOD

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VOL. XXI WASHINGTON, D. C., MARCH 1937 No. 5

Jeff gets us ready for--

The L. G. Jubilee

Jeff McDermid

IF I study a stone in the foothills and then jump at elementary conclusions concerning the geology of the Sierras, I might well go right ahead like a sap and tell you what reforms the land-grant colleges should embrace after I have consulted a flunked frosh, a library janitor, and the queen of the junior prom.

But the gentle art of "bunco publico" in the style set by newspaper guess-givers hardly becomes one who has received everything from land-grant institutions, except a passing mark. Hence I shy from the dangers of over-simplification so common to commentators. I have not their talent for designing the destiny of a city after 10 minutes' rest at a gas-house comfort station.

I turn the tables on them by frankly admitting no authentic data for this anniversary excursion, save that gathered during 20 years "riding the range" of dreary junctions and murky depots and hotels with the extension specialists and other by-products of the Morrill and Hatch enactments. If I am wrong, blame it on my land-grant informants; and when I am right, kindly inform the publishers. They will be more surprised than you are!

At any rate, you are assured of dispassionate, disinterested service from

this corner of mine anent the responsibilities of the land-granters, after mesmerizing economical taxpayers long enough to reach a diamond jubilee! For if you observe, each land-granter has his own pet improvement to advance.

WERE you to consult the teaching staff, they might desire better formulas for releasing unwanted numbers of cluttering freshmen, contrasting this era of excessively fashionable (not popular) education with that of the days of Father Lincoln and his borrowed tomes. They would, in short, transmit to you the semester's accumulation of indoor auto-intoxication induced by too much steam in the radiators and not enough of it in the students, and prove beyond cavil that the crooners have missed an academic hit by not immortalizing the "blue-book blues."

Should you seek advice on new pathways of human progress from the test-tube fraternity, hidden behind rat-cages, or underneath heaps of fermenting cereals, or disemboweling Wyandottes, with all the eclat of the fellows in Gulliver's Travels, you would probably be lucky to elicit a grunt. Peradventure one of them might emerge from a trance to beg for a few more generous philanthropists and nobler fellowships, with fewer importunate students and impatient extension workers.

Were your next attempt in the direction of the extension group, there at last you would see the power of speech and gesture arise like a lark above the feebleness of dictum and dogma. They are the veins and the capillaries which carry the fluids of life from the academic arteries to the hoi polloi. They are the exposed portions of the great body of learning! They get the perfume and the boils, the kisses and the kicks! They must find the ready answer to the yokel's prayer and come up ever smiling with a fresh excuse for every dilatory digression chargeable to lax administration or unfinished research.

And so, my friends, this begins to look a lot like the supreme court situation—too big a case for the time we've got left! Yet I do not anticipate that it will prove to be so vast and horny a bone of contention.

In measuring the past and "periscoping" the future of land-grant colleges, too many critics forget that these institutions cannot escape the common fate of mortals, that of being intensely human and replete with the idealism and theories, the viewpoints and vagaries of historic Americanism. Specialization often sharpens and intensifies the vision to a limited range on the American target. Each one, whether collegiate or illiterate, aims at his favorite bull's eye.

Hence the deans and directors within land-grant portals embrace some of the dreams of magnificent planning and grandiose scheming, characteristic of LeEnfant, Aaron Burr, Jim Hill, Rockefeller, and Frank Lloyd Wright. Others have the inventiveness of Morse and Edison, DeForest and Ford. Some possess in generous degree the showmanship and flamboyant salesmanship of Barnum, Ringling Brothers, and D. W. Griffiths—and perhaps a much fewer number have the self-reliant trail-blazing, issue-facing spirit of Daniel Boone, Lewis and Clark, or Ezra Meeker.

MAGNIFICENCE, invention, salesmanship, and dramatics are all nationally typical and decidedly helpful in a broader life for the common people, in whose interest the land-grant colleges exist.

But if these hobbies of the mode are pursued to the exclusion of courageous pioneering in the face of derision, deprivation, and defeat, then the land-grant college is losing its grip on reality. What Thoreau said is still true, "Our frontiers are not east or

west, north or south, but wherever a man fronts a fact. . . . Be a Columbus to whole new worlds within you!" In jotting this observation down, I must include the four-point spiritual index of land-grant programs given a few years ago by the dean of Oregon

Agricultural College, namely, helpfulness and service, growth and progress, equal opportunity and democracy, and finally, initiative and pioneering.

THIS sage text reminds me of an interview sought with a retiring director of a successful mid-west experiment station, wherein I hoped to tease him into some reminiscences of red-letter days of achievement during the two decades of his administration there. Turning his shaggy head toward me, he remarked, "As you know, I am going into fields of specialized research upon leaving this place. Therefore, knowing as we do that there were moments of pride and periods of disappointment left behind us, I much prefer to talk with you about the future and its opportunities rather than glorify the past, which is dead and immortalized." Coming from a man nearly seventy, this philosophy seemed to me one worthy of wide preachment to that hopeless class of land-grant (or other) leaders, who merely point with pride to the past and weave garlands for moss-grown monuments. Old glories may well serve as a stimulant, but should not be our time-table.

The age-defying character of the best minds in our land-grant colleges remains as the real spur to fresh effort. Dr. Stephen Moulton Babcock was not content to let folks praise him for his contribution to dairy science. He spent his last years silently and busily working both at home and in the laboratory on an involved theory of physics, which was not, as you may suppose, the pottering time-killer of octogenarian whimsy, but a real "lead" which new minds may finish.

TRADITION may well point the way to ambition, or it may cause inhibition, depending on whether one regards academic history as all made or still in the making. We may hastily pass over the small weaknesses and frailities of land-granters, acknowledge their presence, but minimize their effect upon future developments. The "reformers" on the platform who are "deformers" in the classroom, the paper-planners, the splash-water scientists, and others who are long on diagnosis but poor on operations—it is needless to dwell on these few hard kernels in a mess of flaky pop-corn.

One often hears duplication of research as a common fault laid at the land-grant doorway. To the layman like myself, with but a small tithe to pay toward these institutions, I see more difficulty and danger of wasted effort in the realm of animal breeding and veterinary science than I do in the field of plant industry. Plants vary in their soil and climatic needs, making state research fundamentally important; whereas "what ails my bull" in Kansas may likewise cause impotence in Maine or Vermont. Breed a better barley for Iowa, and it may not thrive in Wisconsin or Mich-

(*Turn to page* 44)

The effect of a lack of potash on the ability of corn plants to stand erect. The amount and severity of lodging may often be used as a guide to potash needs.

Better Crops of Better Quality

By M. S. Kipps

Virginia Agricultural Experiment Station, Blacksburg, Virginia

(Graphs prepared by the V. P. I. Office, Virginia State Planning Board from data furnished by author)

HIGH up on the Alleghanies where floods, tornadoes, severe droughts, dust storms, and earthquakes are unknown, but where fertile silt-loam soils and an annual average of 42 inches of rainfall prevails with occasional sub-zero days in winter and 90-degree temperatures in summer, an experiment has been under way for 23 years, attempting to answer some of the difficult questions of farmers. There is one question, however, which farmers forgot to ask until recent years. Is potash needed on our soils for best results?

It has been known that our soils were originally derived from limestone rock and were thought to be high in potash, and because of that fact we have not been exactly potash-conscious. Accordingly, we have been neglecting that part of our fertilizer program. It is true we have been including from 2 to 5 units of potash in our fertilizer mixtures, because we knew that potassium was needed as a proper balancing agent for nitrogen and phosphorus and that perhaps the quantity and quality of the crops were increased. But perhaps we did not know how much this increase would be, especially over a long period of years.

In recent years farmers have begun to ask what the effect of additions of potash to nitrogen, to phosphoric acid,

or to both nitrogen and phosphoric acid had on yields of crops in a rotation. Also from the quantitative point of view, farmers wanted to know what effect potash had on the quality of crops, such as percentage of marketable corn, pulling resistance of corn plants, and percentage of leaning and broken stalks.

Effects of Potash

These questions as well as many others have been answered by an experiment on which corn, wheat, clover, and grass hay have been grown in a 4-year rotation. Several of the treatments of this experiment have been selected to tell the story of the beneficial effects of potash. With the aid of table and graphs, this story is more easily told. The bars of the graphs show increases or decreases produced by the addition of potash to nitrogenous and phosphatic fertilizers, when used alone and in combination.

Considering first the effects of potash on yields of the four crops in the rotation, it is readily observed that in every case additions of potash to nitrogen and phosphorus fertilizers increased the yields of the crops. The average increase in yields of all the crops has been over 34 per cent. The greatest response has been on wheat. The yields of wheat in the four comparisons where potash was added were 53 per cent greater than where the other two fertilizers were used alone or in combination. The other three crops were from 24 to 32 per cent greater in yield where potash was added. In studying the increased percentages of yields of the four comparisons, it was found that where potash was added to phosprorus and nitrogen, an increase of 53 per cent was obtained. In like manner, potash added, to nitrogen produced an increase of nearly 46 per cent in crop yields. There was an increase of over 29 per cent where potash was added when compared to plots receiving no treatment. The increase in percentage of yields produced by adding potash to phosphorus fertilizer was nearly 10 per cent.

Marketable Corn

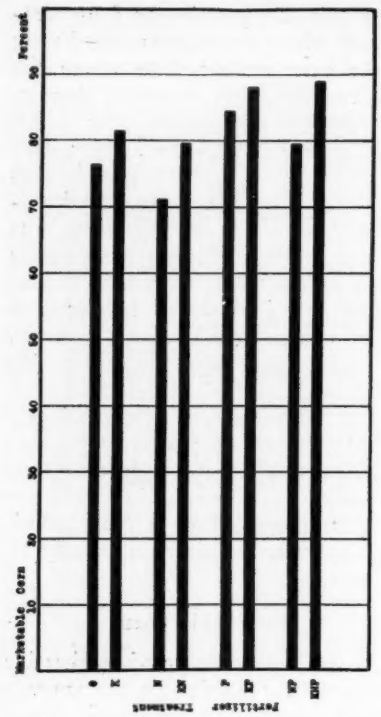
The term percentage of marketable corn is used to designate the amount of good, sound corn harvested. There was a greater amount of good corn on the plots which received potash as a fertilizer. The increase was small—nearly 9 per cent—but its quality was improved just that much.

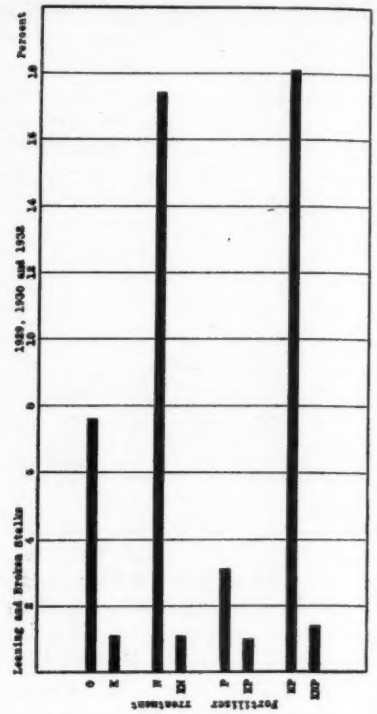
Corn stalks are anchored to the ground by a system of roots. The

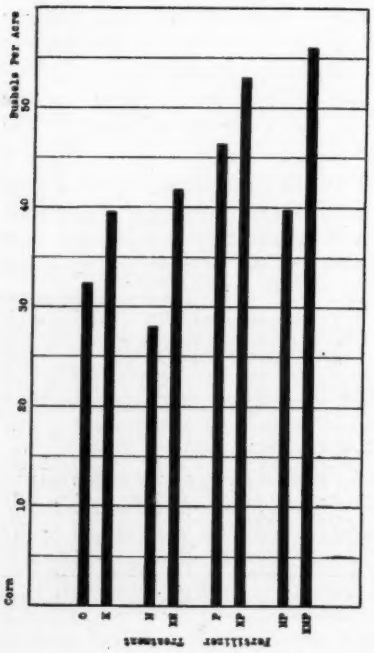
TABLE OF QUANTITATIVE AND QUALITATIVE VALUES PRODUCED BY THE ADDITION OF POTASH TO NITROGEN AND PHOSPHORUS IN A CORN, WHEAT, AND HAY ROTATION.

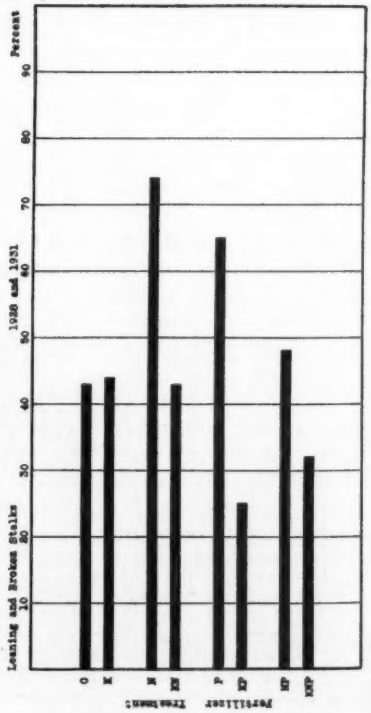
	Average yields of crops grown in rotation (1914-1936)				Percentage marketable corn	Ratio in lbs.		Pulling resistance of corn plants, 1927 to 1932	Percentage leaning and broken stalks	
* Treatment	Corn Bus.	Wheat Bus.	Clover Hay-Tons	Grass Hay Tons		Corn to stover	Wheat to straw		1928 1931	1929 1930 1932
O	32.34	6.40	.82	.96	76.33	.94:1	.48:1	111	43.0	7.6
K	39.52	10.17	1.01	1.11	81.49	1.00:1	.58:1	154	43.7	1.1
N	27.91	5.48	1.01	1.13	71.10	.85:1	.41:1	103	73.9	17.4
KN	41.74	10.66	1.19	1.37	79.61	.97:1	.48:1	174	43.0	1.1
P	46.34	19.28	1.67	1.87	84.53	1.03:1	.58:1	145	65.1	3.1
KP	53.03	19.63	2.03	1.88	88.24	1.00:1	.58:1	208	25.1	1.6
NP	39.78	14.93	1.42	1.51	79.51	1.05:1	.52:1	131	48.2	18.1
KNP	55.97	23.94	2.14	2.43	88.86	.96:1	.57:1	215	32.3	2.1

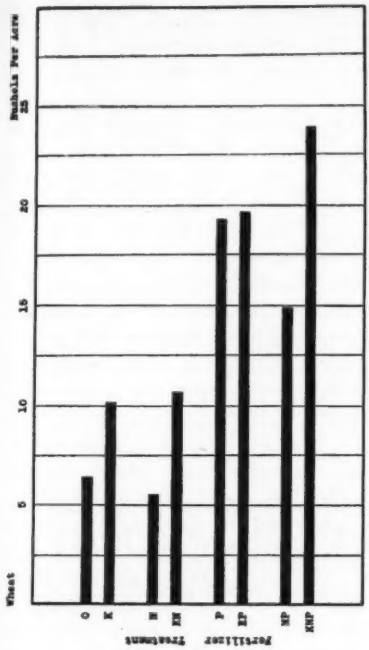
* O—no fertilizer; N—308 lbs. dried blood annually; P—438 lbs. superphosphate annually; K—200 lbs. muriate of potash annually

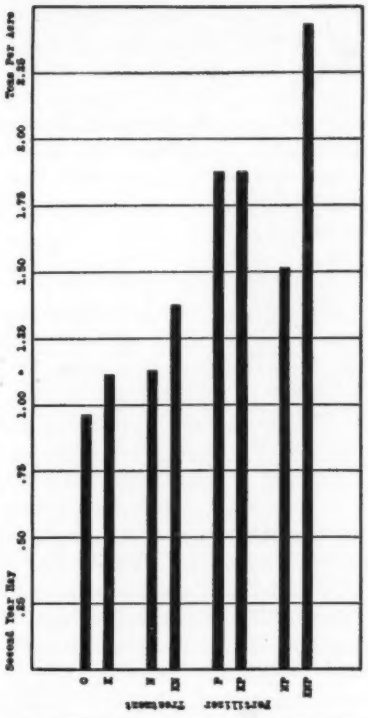

Percent
Marketable Corn
Treatment
Fertilizer

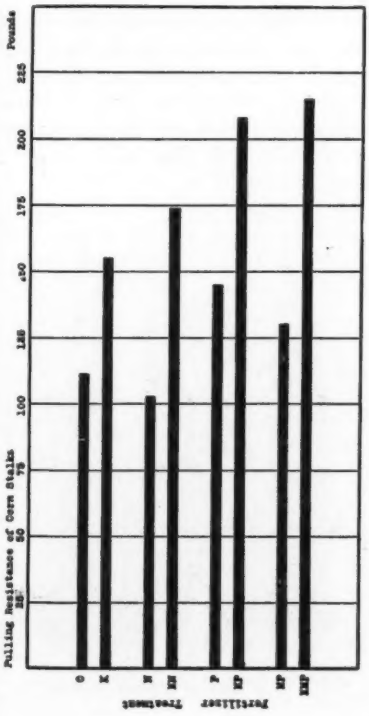

Percent
1929, 1930 and 1931
Leaning and Broken Stalks
Treatment
Fertilizer

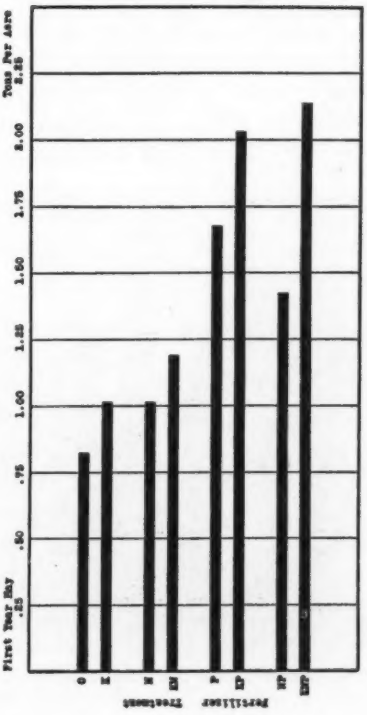

Bushels Per Acre
Corn
Treatment
Fertilizer


Percent
1930 and 1931
Leaning and Broken Stalks
Treatment
Fertilizer


Bushels Per Acre
Wheat
Fertilizer Treatments


Tons Per Acre
Second Year Hay
Fertilizer Treatments


Pounds
Pulling Resistance of Corn Stalks
Fertilizer Treatments


Tons Per Acre
First Year Hay
Fertilizer Treatments

more extensive these roots the better will be the anchorage. It has been known that near harvest time, and especially in certain years, corn sometimes lodged which made harvesting more difficult. It has been noticed in these series of fertilizer plots that the corn lodged more on some plots than on others.

What Causes Lodging?

During a 5-year period, an answer was sought to the question of the effect of fertilizer treatments on this lodging. A count of the leaning and broken stalks on the plots showed conclusively that potash greatly reduced the number, both in wet and dry summers. There were approximately one and one-half times as many leaning and broken stalks in 1928 and 1931 on plots which did not receive potash in the fertilizer treatment as on plots where potash was used. During these 2 years, the total rainfall during the months of July, August, and September averaged 16.4 inches. During the 3 years of 1929, 1930, and 1932, when the total rainfall in July, August, and September averaged 6.4 inches, there was approximately eight times as much lodging on plots not receiving potash as on those receiving potash.

In the 2 years in which lodging was severe (1928 and 1931), about two and one-half times as much rain fell during July, August, and September as fell in the same period in years when relatively little lodging occurred (1929, 1930, and 1932). Weather charts indicate that lodging was encouraged by the concentration of rainfall during the month of August. Thus in years when lodging was severe, nearly one-half of the total amount of rain for the 3 months' period was precipitated in August, while in years in which relatively little lodging occurred only about one-fourth of the total rainfall came during August. Since the rainfall during August in these 2 years of severe lodging was almost twice the average during a 33-year period, the belief is that the excessive rainfall encouraged shallow root development to some extent, and thus lodging was more easily accomplished.

The pulling resistances of corn plants were obtained by ascertaining the number of pounds necessary to remove the plants from the soil by a vertical pull. This pulling resistance

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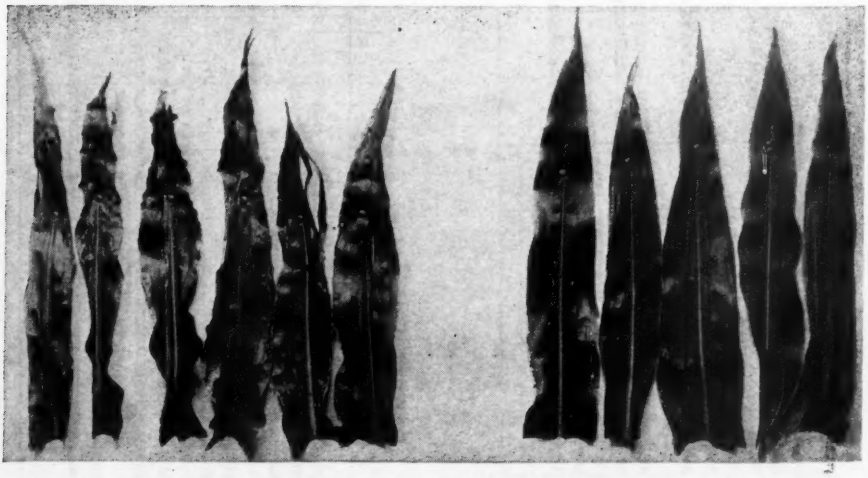

The leaves on the left show burning on the margins, which is typical of potash deficiency. The leaves on the right are normal.

Alabama's Forward March In Fertilizer Practices

By L. O. Brackeen
Editor, Agricultural Extension Service, Auburn, Alabama

A PRACTICAL way of keeping fertilizers which contain ammonium compounds from increasing the acidity of the soil has been developed in Alabama and has proved successful for the past 2 years. It also has shown farmers that it is useless to pay large sums of money for sand as fertilizer filler when valuable materials can be used.

The First Step

That the plan is popular is indicated by the fact that most fertilizers used under general crops in the State are "non-acid forming" and carry dolomite or dolomitic limestone instead of sand as filler. Before the plan was put into operation in 1934 the opposite was true. Records show that in 1933 most all mixed fertilizers purchased in the State were acid-forming, and experiments by the State Experiment Station show that the per-acre cotton yields were being reduced because of the increased acidity of the soil. The seriousness of this increasing soil acidity and the use of sand as a fertilizer filler was called to public attention early in 1934 by the Alabama Experiment Station and the U. S. Department of Agriculture.

"It is estimated that in 1933 approximately 40,000 tons of fertilizer filler were used in Alabama," said Dean M. J. Funchess in reporting the findings of the Alabama station. "This means that approximately 30,000 tons of sand as a filler must have been placed in fertilizers of the State, since about 10,000 tons of limestone or its equivalent were used. This amount of sand represented about 11.3 per cent of the weight of the mixed fertilizers, or 226 pounds a ton. No one would argue that this sand was beneficial to crops, yet delivered to the mixing plants it cost the fertilizer dealers more than $30,000.

"After the sand was mixed with the fertilizer it required the fertilizer freight rate. At $3 a ton the freight alone on the sand after it was mixed with the fertilizer amounted to $90,000. Furthermore, this sand required about 304,510 shipping bags, at 12 cents each, costing about $36,000. Together these items totaled $156,000, all of which was added to the cost of fertilizers to the farmers. In addition to this expense, the filler had to be handled and hauled by the fertilizer companies and by the farmers—a heavy expense for an article as useless as sand.

"The cost items mentioned above are not the only factors affecting the ultimate loss in money to the farmers. The use of sand rather than limestone as a filler has probably meant the loss of approximately 50 pounds of seed cotton per acre on 3,000,000 acres of acid soil in Alabama which should have a total value of $4,500,000, assuming that the increase from limestone in the fertilizer will be as great when a small amount of fertilizer is used per acre as when a large amount is used. A continued decrease in the yield of cotton will undoubtedly result if the

use of sand is continued as the principal filler. On the other hand, if sufficient limestone is added to produce non-acid forming fertilizers then the farmer will be assured that these fertilizers will not reduce the productivity of the soil."

Limestone Replaces Sand

After presenting the above facts Dean Funchess recommended to a joint meeting of the Alabama State Board of Agriculture and leading fertilizer manufacturers, in Montgomery in May 1934, that "most of the sand which is used as a filler for fertilizer should be replaced by limestone." A second joint meeting was held on June 20, at which time manufacturers assured the State Board of Agriculture that they would "gladly cooperate" in producing "non-acid forming" fertilizers by substituting dolomite or dolomitic limestone for the sand filler. The agricultural board then passed a regulation requiring that each sack of fertilizer sold in the State carry a tag labeled "acid forming" or "non-acid forming." Farmers were advised to purchase fertilizers labeled "non-acid forming" for their general crops. As a result, most of the fertilizers, except those bought for truck crops, used in the State do not increase the acidity of the soil because they carry limestone or dolomitic limestone as a filler instead of sand.

Fertilizer manufacturers and dealers have cooperated with farmers and farm leaders during the past 2 years in popularizing another fertilizer practice in Alabama. After years of experiments, the Alabama Experiment Station in 1934 recommended that farmers fertilize their cotton with 600 pounds of 6-8-4 per acre, and asked manufacturers and dealers to assist in making it possible for farmers to obtain this mixture. This they did, with the result that almost 25 per cent of the 468,000 tons of fertilizer used in the State in 1936 was 6-8-4. Farmers all over the State are reporting outstanding results where their cotton was fertilized with this mixture.

"The best fertilizer for cotton on average Alabama land is one that supplies at least 36 pounds of nitrogen, 40 pounds of phosphoric acid, and 24 pounds of potash per acre," said Dean Funchess in recommending the new mixture to farmers. "To supply these amounts of plant food it would require 225 pounds of nitrate of soda or the equivalent, 300 pounds superphosphate, and 48 pounds of muriate of potash, or a 6-8-4 fertilizer applied at the rate of 600 pounds per acre."

"This amount of fertilizer per acre," he said, "may seem excessive, since the average amount of low grades of fertilizers is about 300 pounds per acre. However, tests show that 600 pounds per acre of a 6-8-4 fertilizer produced 221 pounds of seed cotton per acre more than a 300-pound application. After considering the cost of these amounts of a 6-8-4 fertilizer and the value of the seed cotton (4 cents per pound) the 600-pound application was more profitable than the 300-pound application by $5.38 per acre.

Applying Fertilizer

"If a 6-8-4 fertilizer is used at the rate of 600 pounds per acre it should be applied in a wide stream at the bottom of the furrow marking the row, and mixed thoroughly with the soil which should be bedded at least a week before planting. Allow time for a rain to fall and settle the bed. In the event that 300 pounds of 6-8-4 are used (even though it is not the most profitable rate) it may be applied in any manner in which 300 pounds of any other grade of fertilizer may be applied.

"In using a 6-8-4 fertilizer at any rate up to 600 pounds per acre a farmer is saved the time and expense of side-dressing cotton. This fertilizer contains sufficient nitrogen and the cotton which received it should not be side-dressed.

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Will Potash Benefit Your Apple Orchard?

By J. K. Shaw
Pomologist, Massachusetts State College, Amherst, Massachusetts

A PRODUCING orchard draws from the soil more potash than nitrogen. Yet the results of many years of experimentation prove that apple trees respond to nitrogen-carrying fertilizers far more distinctly than they do to potash, either alone or added to nitrogen. In fact the majority of investigators report no direct benefits whatever from the use of potash in the orchard. Consequently most but not all Experiment Stations have recommended the use of only nitrogen in orchard fertilization. This would seem to indicate that apple trees are able to absorb the required potash from the reserve in the soil to a greater extent than do many other farm crops, many of which very often respond to potash-carrying fertilizers.

The total amount of potash in most good agricultural soils is large, especially, if we take into consideration the soil to the depth to which apple tree roots may penetrate. Most good soils contain enough to satisfy the demands of large crops of apples for more than 100 years. But most of this soil potash is locked up in unavailable forms and it is difficult to see how the trees obtain their supply more readily than other crops. It has been shown that tree roots may be more or less active through the entire year and possibly they may be able to take up potash more or less constantly as it is slowly made available by natural processes going on in the soil. The deep rooting habit of apple trees in well-drained soils may be a factor; they have a large body of soil to draw from. Possibly apple roots may in some way be able to render more of the soil potash available than do some other plants, though there seems to be no proof that this is true.

Severe potash deficiency in the apple shoot at the right shows the short slender growth and burned leaves characteristic of severe potash shortage.

In the last few years there have appeared from several sources reports more favorable to the value of potash in orchards. In England and other European countries it is generally regarded as quite as important as nitro-

gen. There seems to be a slowly increasing belief among investigators in this country that potash should not be entirely neglected in orchard fertilization. Is this belief well founded or should we go slow in recommending potash?

It is well known that when soluble forms of potash are applied to the soil it may be quickly locked up in unavailable forms before the plants are able to absorb it. Some of our orchards at the Massachusetts Experiment Station are clearly suffering from a potash deficiency. In one of these orchards we have applied potash for three successive years at the rate of about 3 pounds each to 20-year-old trees growing under strip cultivation. In the first year there was no indication of any effect whatever. In the second year there was a clear indication of an increased potash content in the fertilized trees but no change in their growth or appearance. In the third year the trees grew better, had a greater leaf area, and a noticeably improved appearance when compared to the check trees that continued to receive only nitrogen fertilizer. Other experiments in our orchards suggest that it may be 3 years or more before potash-deficient trees respond with better growth and heavier production.

Severe potash deficiency on the peach. The two shoots at the right are badly injured from lack of potash.

Results of Test

We have at the Massachusetts Experiment Station one of the old soil test fields. It contains 13 plots which since 1889 have received moderate annual applications of nitrogen, phosphorus, and potash, alone and in combination. Up to 1921 various field and market garden crops were grown. In that year the field was planted to apple trees and other fruit plants. The plots are too narrow to allow trees to come to maturity, so in 1930 the trees were removed and other apple trees on their own roots planted.

The growth of the apple trees on these plots has been most unusual. Half of each plot has been limed to maintain a soil pH of about 6.25; the other half has never been limed, and during the period under consideration the soil pH has been about 4.50 to 5.00. Whenever potash is used either alone or in combination, trees on the limed half of the plots have grown better than the unlimed trees, while the reverse is generally true on plots fertilized with nitrogen or phosphorus or both. The entire nitrogen plot presents a rather sorry sight. The largest trees are to be found on the unlimed half of the nitrogen-phosphorus plot and for some reason these trees contain abundant potash which is not true on the limed half. And this plot has had no added potash for nearly 50 years.

Under the conditions of this field potash seems to be more helpful than nitrogen though both appear to be beneficial and a complete fertilizer plus lime seems the proper fertilizer.

(*Turn to page* 38)

Prevent Blackening Of Irish Potatoes

By E. O. Adair
Madison, Wisconsin

POTATO growers and housewives are welcoming the news that blackening of cooked potatoes is less likely to occur where the right amount of available potash has been supplied to the soil and that it is not due to the variety of the potato, immaturity, methods of storage or cooking. These facts are becoming known as the result of scientific research carried out at the University of Wisconsin under the direction of Dr. W. E. Tottingham.

The blackening of cooked potatoes displeases housewives and other consumers who not only want potatoes to furnish wholesome food, but to be tempting and attractive when served. Potato growers, anxious to meet discriminating consumer demands, are interested in overcoming the difficulty. For these reasons and the fact that the undesirable condition is appearing in various parts of North America, Dr. Tottingham and his assistants attacked the problem.

Distinguishing Features

This type of blackening occurs soon after harvest. Since it appears then, the condition may be distinguished from the darkening which frequently accompanies advanced stages of sprouting in spring storage. The discoloration in question is usually most prevalent in the layers of the tissue which lie just beneath the skin. It is usually found in the stem end of the potato, although it may affect all portions resulting in a more or less gray or even blue appearance throughout.

Consumer responses indicated that the trouble was particularly serious in 1931 and 1933. Both of those years were hot and dry during the early and late summer and especially in the principal potato producing areas of Wisconsin. The blackening occurred therefore in the potatoes that were grown when the availability of the plant food should have been low and when the plant processes should have been affected by the intense heat. Then, too, the fact that less fertilizer was purchased during the depression is another factor which should be considered contributory to the crop condition during those years.

Early History

The discoloration of cooked potatoes was observed, however, before the recent drought or depression. As early as 1921, Wallace of England reported this condition in one of two varieties which had been fertilized with manure and commercial nitrogenous fertilizers following a hot dry summer. In this case the trouble was largely overcome by the addition of a low plane of potash to the other fertilizers.

Dr. Tottingham states that one of their first concerns in approaching the problem was the possibility that the abnormality was caused by disease. If this were true, it might be transmissible from the parent to the succeeding crop. This, however, was disproved when trials in two seasons on

field plots at several locations failed to disclose the relation suggested. It appeared that the discoloration was dependent upon physiological factors in the growth of the plant.

"Early in these investigations, potatoes from the same parent stock were obtained. These potatoes were grown on peat soil to which had been added equal amounts of 0-20-0 and 0-20-20 fertilizers. The tubers grown on soil fertilized with potassium remained white throughout after cooking while the others were bluish throughout and the tissue black at the stem ends," Dr. Tottingham says.

Potassium Deficiency

"From the preliminary observations, we proceeded to a study of potato discoloration in relation to the potash content of the soil. In making the study, we tested varieties including Burbank, Cobbler, Katahdin, and Rural New Yorker. Plots of one-eighth acre were laid out on the silt loam at Madison, sandy loam at Arnott, and silt loam at Antigo. At the time of planting the available amounts of potash in the soils (as measured by the Truog method, a rapid means of determining the readily available potash of soils) were respectively 300 to 400, 200 to 250, and 150 to 200 pounds per acre.

"Application of a 2.5-10-18 fertilizer was made at the rate of 600, 400, and 740 pounds per acre at the respective stations. The fertilizer was placed in the furrow. The responses obtained showed a general relation of discoloration to potassium deficiency, irrespective of the variety of potato. The findings are presented in the table. Similar results were obtained in a greenhouse on a synthetic sandy soil containing 125 pounds of available potash."

Similar results were obtained from all varieties of potatoes used in the experiments. Application of 1,200 pounds of 4-10-20 fertilizer produced Cobbler and Russet Burbank tubers in yields approaching 150 bushels per acre free from blackening after cooking. However, an equal amount of potash-free fertilizer produced less than 100 bushels of potatoes per acre, which discolored.

The effect of the rare elements in this connection is significant too, states Dr. Tottingham. "Tubers from heavy yields of different varieties containing low proportions of potash as produced on pure sand supplemented

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COMPARISON OF AVAILABLE POTASSIUM IN THE SOIL WITH DISCOLORATION OF BOILED POTATOES IN THE 1935 CROP.

Location and available K_2O content of soil	Fertilizer elements applied	Plot number	Variety of Potato				
			Burbank	Cobbler	Katahdin	Rural New Yorker	
						Normal seed stock	Discoloring seed stock
Antigo 150-200	N-P-K	1	*	0	*	0	0
		2	0	*	0	*	*
	N-P	1	*	*	*	*	*
		2	*	*	0	*	*
	none	1	*	0	*	*	*
Arnott 200-250	N-P-K	1	*	0	0	*	0
		2	0	0	0	0	0
	N-P	1	*	0	0	0	*
		2	*	0	0	0	*
	none	1	0	0	0	0	0
Madison 300-400	N-P-K	1	*	0	0	0	0
		2	0	0	0	0	0
	N-P	1	*	0	0	0	*
		2	0	0	0	0	*

0—White after boiling

*—Gray to black after boiling

New Fertilizers for Ontario Tobacco

By H. F. Murwin
Superintendent, Dominion Experimental Station, Harrow, Ontario

QUALITY of the tobacco produced is one of the factors responsible for recent developments in the tobacco industry of Ontario. Out of the rapidly changing picture of a few years back has developed an industry which is now furnishing a steady source of income for several thousand farmers in the southern peninsula. Flue-cured tobacco will constitute approximately 80 per cent of the 60,000-acre crop planned for 1937. Due credit also must be given the buyer-grower organizations for their guidance and stabilizing influence in the matter of production and marketing of tobacco during this development. These are the things that make for a successful industry.

Tobacco manufacturers' requirements change, thus necessitating changes in fertilizers as well as varieties and cultural practices. Aside from these changes, improvements are being made in fertilizer mixtures. A newly recommended tobacco fertilizer is not simply a new model. Such a fertilizer is so made up that it will produce better-quality tobacco if given a fair chance. The same as in other industries, ways are discovered to improve an article offered for a specific purpose. One of the older models, the 3-8-4, has served its time. The 2-10-8 mixture, a better-balanced fertilizer for flue-cured tobacco, has taken the road and is "going places." But, how and why have such changes taken place?

Each year the information obtained from tobacco fertilizer experiments

Chlorosis or mottling, indicating potash starvation, begins at the leaf tip. The leaves curl under and localized dying of th. tissue occurs.

conducted in the Province of Ontario is reviewed by the Standing Committee on Tobacco Fertilizers. Fertilizer recommendations for tobacco are formulated by the committee and are discussed in detail with the fertilizer manufacturers before being passed on to the producer. The splendid co-operation received from representatives of the fertilizer trade has afforded an opportunity for putting into practice mixtures that have proved superior in experiments. From this has developed the registration of certain mixtures by various manufacturers as "tobacco fertilizers."

For Quality and Yield

Although fertilization of tobacco is but one of the factors responsible for quality, it is a very important factor. Experiments have proved the value of commercial fertilizers for tobacco. If an unbalanced fertilizer is applied, however, either the quality or the yield may be lowered even with the best of soils, varieties, and cultural practices. Likewise, proper soil must be available, one of the better varieties must be grown, and proper soil management must be practiced to receive maximum results from the fertilizer applied.

Experimental work has been conducted over a period of years at the Dominion Experimental Station, Harrow; at the Dominion Experimental Substation, Delhi; and on farms throughout the tobacco districts in an effort to determine the fertilizer mixtures best suited for the different types of tobacco. The information obtained from these studies is based on field growth, maturity, yield, and quality of tobacco produced in field-plot experiments, and is further supported by commercial tests based on experimental results.

Less nitrogen and more potash are now required for best results in the production of flue-cured tobacco. Recent experiments definitely indicate that a flue-cured tobacco fertilizer should contain 2 per cent nitrogen, about 10 per cent phosphoric acid, and at least 8 per cent potash for best results under average conditions. In these tests potash was found to be the most important part of the fertilizer mixture affecting the quality of tobacco. A 2-10-8 fertilizer is recommended under average conditions for flue-cured tobacco. The recommended rate of application is 800 to 1,000 pounds per acre.

Soil fertility and drainage vary considerably in some of the flue-cured districts, and it is fully realized that one fertilizer may not best suit all conditions. Where potash levels in the soil are low, the potash should be increased in the fertilizer used. In such cases a 2-10-12 fertilizer may be used to advantage. Likewise, where slow maturity has been experienced on some of the low-lying soils, a 2-12-6 fertilizer will tend to hasten maturity and may better suit such conditions.

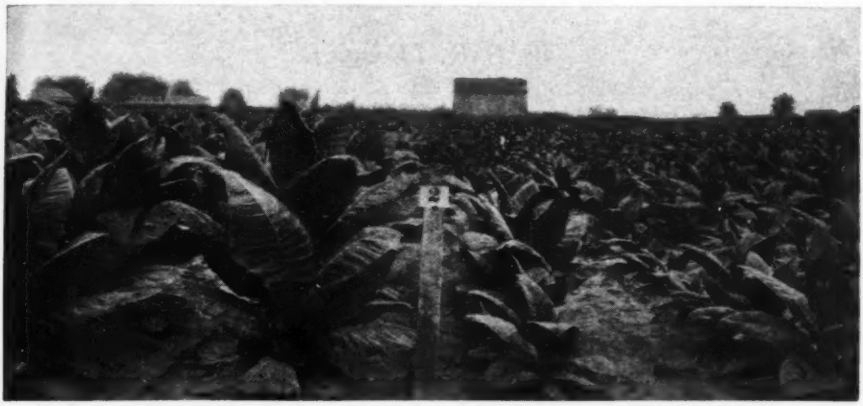
Some of the experimental results upon which the recommendations are based are given in table 1. This information shows the value of nitrogen, phosphoric acid, and potash in a flue-cured tobacco fertilizer and serves to illustrate the general trends obtained. Each figure on yield and value represents the average of four treatments conducted over a 3-year period and covers a range of seasonal conditions.

TABLE 1. FLUE-CURED TOBACCO FERTILIZER TESTS AT DELHI SUBSTATION, 1933-35 INCLUSIVE.

Fertilizer Formula	Acre Yield, lbs.	Value, ¢ per Pound	Value, $ per Acre
Varying Nitrogen—			
1-10-6	1,010	23.4	236.34
2-10-6	1,070	22.2	237.54
3-10-6	1,120	20.6	230.72
Varying Phosphoric Acid—			
2-4-6	1,130	19.3	218.09
2-10-6	1,140	19.8	225.72
2-16-6	1,080	21.2	228.96
Varying Potash—			
2-10-3	1,010	19.5	196.95
2-10-6	1,090	21.7	236.53
2-10-12	1,220	24.6	300.12

Soil type: Fox coarse sand.

The low average values are principally due to low prices in 1933 and low yields due to frost damage in 1934. The 1935 season was a very favorable one, and during that year average yields and values per pound were about 1,550 pounds and 33 cents, respectively.



Tobacco requires a well-balanced fertilizer, as shown by the greatly improved growth on the left from 1,000 lbs. of 4-8-12 per acre when compared with 1,000 lbs. 4-0-12 on the right.

Potash is equally as important in the fertilization of burley tobacco. A fertilizer carrying high potash is required to produce the best burley, particularly on the sandy-loam and gravelly-loam soils. The clay-loam soils in general respond somewhat differently, requiring high phosphate in the fertilizer for best results. There is not as much response from potash applications on clay-loam soils as there is on the lighter burley soils.

Recommendations

Tests conducted over a period of years by the Experimental Station at Harrow definitely show the value of potash on the sandy-loam soils. Recent experiments also definitely indicate that high potash is required on the gravelly-loam soils and on some of the other intermediate soils in the tobacco area. As a result of these tests a 4-8-10 fertilizer is recommended on the sandy-loam and gravelly-loam soils. Where potash levels are low, still higher applications of potash may be used to advantage. In contrast, a 2-12-6 is recommended on the clay-loam soils because on these soils a greater response is obtained from phosphate than from potash.

With the wide range of soils utilized in the production of burley tobacco, it is readily understood that neither of these two fertilizers will best suit every condition. Tests during the past season throughout the burley tobacco districts indicate that some of the heavier gravelly-loams as well as some of the intermediate loam soils would require a fertilizer high in both phosphate and potash. A 4-12-10 or a 2-12-10, depending on the nitrogen levels in the soil, gave best results on these soils. The recommended rate of application is 500 to 1,000 pounds per acre. At least a 500-pound application has always given better results than a lower quantity, and the tests show that higher rates pay good returns for the extra investment. An application of barnyard manure is rather taken for granted in this discussion of burley fertilizers. A combination of manure and a well-balanced fertilizer has given best results. The recommended

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A Winning Campaign Against Wheat Smut

By E. R. Jackman
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SMUT has always been one of the stoutest foes in the army constantly threatening the wheat grower. If it isn't one thing, it's two in his troublous existence anyhow. Hail, drought, freezes, untimely rains, too much heat or cold—all of these things lie ready to smite him hip and thigh, and he can't do much about it. Smut and rust are the twin wheat diseases. For years they were considered somewhat resignedly, in the same list as weather hazards, but both are now on their way out, and by the same means, resistant varieties.

The most common wheat smut, named bunt by the scientific gentlemen and called by the unlovely name of stinking smut to distinguish it from loose smut, is ordinarily the worst of the twins, because in order to develop it needs no favorable climatic conditions such as rust needs. It will develop most any time, anywhere. Annual losses in the U. S. run into the millions.

Losses From Disease

These losses occur in several ways. First, is the direct loss in yield; second, the loss because of smut dockages and washing charges assessed against the wheat; third, the freight on the dockage which the farmer pays whether he knows it or not; and fourth, the cost of seed treatment. Losses are much higher in some sections than in others. Seed treatment, for example, is a pretty sure remedy east of the Mississippi River. But in the areas where not much but wheat is grown, and especially in the summerfallow areas of the Pacific Northwest, seed treatment may be ever so thorough and still the loss may be severe through soil infection.

Seed or Dust?

The first organized fight against it and the one still going on in some sections took the form of seed treatment. Originally formaldehyde or bluestone was used as a wet treatment. Both were dangerous and frequently led to yield reductions which were more serious than losses from smut. Then the Australians showed us how to use copper carbonate as a dust treatment. This was adopted with enthusiasm in the Pacific Northwest, and by 1923 nearly 100 per cent of the wheat growers used it. It was not many years until it had spread all over the wheat states.

But the copper carbonate had disadvantages, too. It was acutely uncomfortable to the user; grain left over night in drills tended to "cake," causing broken grain drills; equipment for treating had to be bought or made. Chemists therefore began to search for other forms of dust, and after several false starts evolved a mercury compound which is both cheaper and better than copper carbonate. It is available on the market wherever wheat is grown.

So that brings us to the resistant

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The Agricultural Future of Puerto Rico

By D. E. Haley
Pennsylvania State College of Agriculture, State College, Pennsylvania

A VISITOR to Puerto Rico soon realizes that he is enjoying a rare privilege. As the ship nears the northern coast, plowing through the deepest waters in the seven seas, the first view of the Island is of rugged mountain ranges, which extend east to west through the interior. These do not exceed 4,400 feet in height, but are quite distinctive and beautiful, with rather sharp peaks and ridges, covered with vegetation. Graceful cocoanut palms, with occasional royal palms, fringe the Island. To one who views tropical vegetation for the first time, the experience is long to be remembered. As seen by Columbus (this was the only "American" soil he visited) it must have been even more beautiful. Some of the native forests still stand. One on the summit of El Yunque Mountain is said to be the most outstanding example of a rain forest in the world. Here giant ferns grow over 20 feet high.

As the steamer approaches the splendid port of San Juan, the largest city on the Island and the point where most visitors land, there appears on the sky line the rugged outlines of Morro Castle. This fortress, which is also beautiful in architectural design, played a prominent part in the early history of Puerto Rico. It was here that Drake, Hawkins, and Cumberland were repulsed when they tried to capture San Juan from the sea. It was here that a shot was fired at a German ship during the World War; this was the only shot fired at an enemy from American soil during that war. Close to Morro Castle is the Governor's Palace, a marvelous structure rich in historical background. It now is occupied by the Hon. Blanton Winship, the Governor of the Island, an able and conscientious administrator, of whom Americans may well be proud.

Not far from the point of disembarkation is the cathedral in which are the bones of Ponce de Leon, who sought to find in the New World the "Fountain of Eternal Youth." Ac-

The Federal Experiment Station at Mayaguez.

cording to some enthusiasts, his mission would have been partially fulfilled if he had discovered Coamo Springs in southern Puerto Rico, the medicinal value of which is internationally recognized.

San Juan is a very interesting city, and is rich in history and traditions. If one expects to find here the modern conveniences of an American city, he is doomed to disappointment. The Spanish rather than the American type of architecture will no doubt prevail for years to come.

Puerto Rico is said to have both a summer and a winter season. To a visitor from the American mainland, however, it seems to have but one continuous summer season. If the Island is visited during the so-called summer season and an auto ride is taken into the interior, the highways are lined with flamboyants which form a beautiful archway over the road. Fragrant, scarlet flowers cover these trees; the petals slowly fall and blanket the road. It is a driveway of "living fire;" the wind, lifting the fallen petals, gives a weird effect of "pulsing flames."

Unrivaled Scenery

At some points, especially on the old Spanish Military Road, one rides dangerously near the edge of a bare precipice. At other points from high elevations there is a view of scenery not duplicated in any other part of the world. One of these high points is Las Mesas, near the city of Mayagüez, where the Federal Experiment Station (headed by Dr. Atherton Lee) and the Agricultural College are located. If this is viewed at the time of a gorgeous Puerto Rican sunset, the grandeur of the scene — mountains, lowlands, and the sea — beggars description. It may be fittingly described only by a poet, an artist, or romanticist—certainly not by a scientist.

The wild life found in similar tropical regions elsewhere is absent here. A stillness permeates the Island. It implies peace. But the Island has not always been peaceful. In the early days, the Caribs, the most warlike of American Indians, were found here. They fought the Boriqueños—people from Boriquen, "Fatherland of Valiant Men," and other Indians, as well as the whites who discovered and colonized Puerto Rico.

Continuous Growing Season

Records at San Juan show a mean temperature of 77.9° F., a maximum of 94° F., and a minimum of 62° F. This is characteristic of the lowlands, but it is cooler in the mountains. Nowhere, however, has frost been known. This temperature assures the Island of a continuous growing season, but some plants thrive better at one time of the year than at another. The sunshine is brighter and more active in Puerto Rico than on the American mainland, since there are less dust particles to obstruct the rays. It is interesting to note that there is an average daily illumination equal to 10.9 hours, notwithstanding the cloudiness of many rainy days.

In the Luquillo Mountains the rainfall averages 145 inches annually. At Ensenada, in the western end of the south coastal plain, it is 26 inches. Here, and in certain other areas, irrigation is practiced. On the average the rainfall is ample over the major part of the Island. Excess rainfall is now turned into an asset, being used for the generation of electric power.

The time is not far distant when illiteracy will be unknown. Even now, most of the laborers are literate. Puerto Ricans are the soul of hospitality. Contrary to what one might expect of those living in a tropical environment, the people are hard-working and ambitious. They are an agricultural people and are willing to undergo hardships in order to obtain a living from the soil.

Puerto Rico is one of the most

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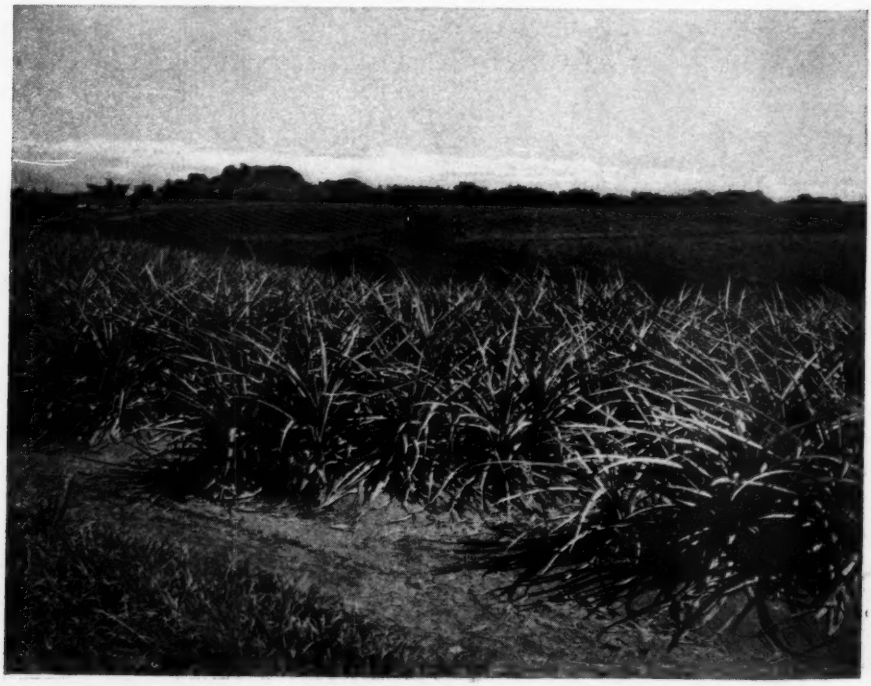
Above: Tobacco is the second largest export crop of Puerto Rico. This scene taken from a typical farm shows the soil ready for planting. Below: Sweet potatoes growing in the foreground, with sugar cane, the largest export crop, furnishing an appropriate background.

Above: A "hacienda" coffee farm near Ponce. Below: Fields of pineapple contribute to the picturesqueness of the landscape.



Above: A tobacco district in the La Plata Valley. Below: Cucumbers growing on the Garcia farm located between San Juan and Cagas.

Above: Experimental work on "terracing" at the Federal Experiment Station at Mayaguez. Below: An experiment field of Puerto Rican tobacco which received a high potash treatment.

The Editors Talk

Soil-Builders or Exhausters?

When is a soil-builder not a soil-builder? The answer is being found by thousands of conscientious farmers who for years have thought they were using soil-improving practices and then discover their crops showing symptoms of plant-food starvation and their yields decreasing. For instance the lime-phosphate-legume system, once felt fully adequate for the fertile soils of the Midwest, has proved itself a soil-depleting practice. So great has been the drain on the available potash in these soils, that much corn is showing the yellow streaking and edge scorching of leaves, root rots, lodged stalks, and yields of chaffy ears of poor feed value, which are the characteristic signs of potash starvation.

C. B. Williams, Head of the Department of Agronomy, North Carolina Experiment Station, in a published article appearing in the South last fall tells how crops must be used to justify the term—"soil-builders." He points out that when crops are grown on any land and, after their growth, they leave the land more productive for the crops which follow, they can be termed soil-improving. If the only limiting factor of a piece of land is the poor physical condition of the soil, the growth on it of non-leguminous crops like rye, oats, and millet and turning these under after growth should in most cases remedy this defect and materially improve the productiveness of the soil. On the other hand, if the trouble with the soil is lack of sufficient quantities in available forms of any one of the essential constitutents, like nitrogen, phosphoric acid, potash, lime, and magnesia, no reasonable amount of turning under of non-leguminous crops will be likely to make the soil a productive one.

He further points out that when legumes, the only class of crops that can gather and store in the soil any essential plant-food element, and these only nitrogen, are cut and removed from the land, they will not ordinarily add any more nitrogen to the soil than they removed from it. Legumes grown on land and removed for hay or any other purposes can hardly be classed as soil-improving crops. Under such a system of management, the nitrogen supply of the soil will just about be maintained and there will be a loss of from 8-16 pounds of phosphoric acid and 26-54 pounds of potash from the available supplies in the soil for each ton of legume hay removed. To replace these plant foods, it would require the addition to the soil of from 50-100 pounds of 16 per cent superphosphate and 51-108 pounds of muriate of potash for each ton of legume hay removed.

Professor Williams tells North Carolina farmers that they may be surprised to know that legumes, generally, grown and removed from the land are much more exhaustive upon the available phosphoric acid and potash reserve per hundred pounds removed than are most of the other crops so grown and removed. For the growth of legumes to be of help in building up

the productiveness of any land, at least a good portion of them must be turned back into the land either in their entirety or after picking or harvesting the seed. This does not mean they will add to the supplies of available phosphoric acid, potash, and lime, which they cannot possibly do; but they will add organic matter, which many soils need, and will increase the nitrogen content of the soil.

The increasing use of soil tests is playing an important role in ascertaining present levels of availability of the essential plant foods. Farmers taking advantage of this knowledge and applying fertilizers well balanced accordingly are on the way to real soil-building.

Placed for Full Value

Growers who would get full value from the fertilizers which they are buying this spring must place these fertilizers where the respective crops can get to them and make the most efficient use of them. It is estimated that around 7,500,000 tons of commercial fertilizer will be used this year. About half the cost of this plant food can be returned to the farmers by additional yields, over and above the normal increased yields from the use of fertilizer, which will be obtained by putting the fertilizer in the right place, thus increasing profits.

To illustrate: B. E. Brown of the Bureau of Plant Industry and G. A. Cumings of the Bureau of Agricultural Engineering, U. S. Department of Agriculture, tabulated results of fertilizer placement studies on potatoes over 4 years in Maine and Virginia and 5 years in New Jersey. In Maine the yield from side placement of fertilizer averaged 35 bushels more than when the same quantity of fertilizer was placed in a band under the seed, and 43 bushels more than when the fertilizer was mixed in the row. In New Jersey the corresponding averages were 44 bushels and 24 bushels greater; in Virginia 33 and 20 bushels. These additional yields, they point out, are strictly the result of the placement of the fertilizer where it will do the most good in feeding the plant. In these states growers commonly apply a ton of fertilizer to the acre for potatoes, and this amount was used in these tests. This fertilizer ordinarily costs from $30 to $40 for each acre of potatoes. How large a share of this expense can be written off by improving the placement of the fertilizer depends, of course, on the extra yield and on the price of potatoes, but Brown and Cumings estimate that at normal prices the extra yield would ordinarily pay approximately half of the fertilizer cost.

Placement studies have been made on corn, cotton, sugar beets, potatoes, white beans, wax beans, peas, lima beans, kale, cabbage, spinach, tomatoes, and tobacco. Results indicate that in general the fertilizer is of the greatest benefit to the crop when applied in a band at each side of the row. Placement about 2 inches to the side of the seed or plant and about 3 inches below the surface of the ground is the best in most cases. Speediest germination, quickest plant development, and highest yields resulted.

Many growers already possess equipment with which they can govern the placement of the fertilizer. Those who contemplate purchasing new planters or fertilizer distributors should make sure that these machines will meet this requirement.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture and the State Experiment Stations relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizer Experiments with Hay Crops in the Connecticut Valley," New Hampshire Agricultural Experiment Station Circular 50, gives a comprehensive report of the trials with fertilizers and lime for forage crops that were carried out in an important dairy farming region located in the valley area. The authors, F. S. Prince, T. G. Phillips, P. T. Blood, and G. P. Percival, conclude from these studies that farm manures apparently do not carry sufficient phosphorus and potash for a normal crop of legumes. They state that should enough manure be applied in order to furnish enough of these two elements for such crops, a great waste of nitrogen would result, and at the same time the ratio of the plant-food elements would not be in balance.

The most serious need for fertilizers for the crops studied, as measured by yield increases, is for potash. Although phosphorus, nitrogen, and lime when used caused increases in the alfalfa-timothy mixture grown during the first 3 years of the experiment, potash influenced yields most. Potash was more effective when used with lime or phosphorus, or both, on the alfalfa mixture. The results obtained when used conjointly with these materials were more than additive. The response of red and alsike clovers was striking to both potash and phosphorus. Very significant returns in the value of hay produced from each fertilizer material used alone and in different combinations are shown in the publication. According to these calculations, $1 invested in nitrogen when applied with phosphorus and potassium gave a return of $3.89 in hay. An investment of $1 in potash used with lime and phosphorus returned $5.93, and used alone returned a value of $3 in the hay.

A revised edition of Indiana Agricultural Experiment Station Circular 204, "The Use of Rapid Chemical Tests on Soils and Plants as Aids in Determining Fertilizer Needs," by S. F. Thornton, S. D. Conner, and R. R. Fraser, gives a thorough description of soil and plant tests to obtain valuable indications of available plant-food supply from which better fertilizer recommendations can be made. While only a few changes of the original manuscript are made in this circular, certain considerations are explained more fully and should result in a wider and more effective use of these tests. Rapid chemical tests on soils and plants offer a practical and inexpensive method for determining soil reaction (acidity) and availability of plant nutrients. The system of testing outlined makes use of practically identical reagents, equipment, and technique for both soil and plant tests. With these soil and plant tests, very low results for any nutrient indicate a definite need for this nutrient for all crops under practically all conditions. Very high tests show an adequate supply. It should be evident that no general interpretation of test results, applicable to all crops, at all yield levels, and for all soil and climatic conditions, is possible. Full consideration should

be given to other plant-growth factors, such as soil type, water supply, and other physical factors which influence fertilizer efficiency and potential productivity. Full directions for taking soil and plant samples for testing and colored charts to aid in interpreting the results add to the value of this practical and useful handbook on short-method testing.

"Methods of Incorporating Organic Matter with the Soil in Relation to Nitrogen Accumulations," Agr. Exp. Sta., Columbia, Mo., Res. Bul. 249, Dec. 1936, W. A. Albrecht.

"Nitrogen Nutrition and Chemical Composition in Relation to Growth and Fruiting of the Cucumber Plant," Cornell Univ., Agr. Exp. Sta., Ithaca, N. Y., Memoir 192, July 1936, R. B. Dearborn.

"Irish Potato Fertilizer Experiments," Agr. Exp. Sta., Clemson, S. C., Cir. 55, Nov. 1936, H. P. Cooper, W. D. Moore, and R. W. Wallace.

Soils

According to Chief Henry G. Knight in his "Report of the Chief of the Bureau of Chemistry and Soils, 1936," the Bureau planned and organized 3 new projects during the past year as a part of the U. S. D. A. program of basic research in agriculture, provided for in the Bankhead-Jones Act of June 29, 1935. These are: (1) Research into the industrial utilization of soybeans and soybean products; (2) the chemistry of enzymes and enzyme action at low temperatures; and (3) a study of the allergens of agricultural products. In addition, the Bureau planned work in cooperation with the Bureau of Plant Industry on a Bankhead-Jones project for the study of plant viruses. Results of the research activities of this Bureau during the fiscal year 1936 are reported briefly in this report. Since actual experimental work on the new projects mentioned above was just getting under way at the close of the year, no report of progress is included. More information concerning many of the items discussed may be obtained from the 231 publications emanating from the Bureau during the year which are referred to at the end of Dr. Knight's report.

A number of recent bulletins dealing with land and water conservation will be found highly instructive to many who are interested in practical conservation methods. The varied subject matter contained in these publications is, to a large extent, applicable to nearly all regions. The bulletins of greatest interest which we classify under this heading are the following: "Sheet Erosion Studies on Cecil Clay," Alabama Agricultural Experiment Station Bulletin 245, by E. G. Diseker and R. E. Yoder. "Peat Land in the Pacific Coast States in Relation to Land and Water Resources," Miscellaneous Publication 248, U. S. D. A., by A. P. Dachnowski-Stokes. "Silting of Reservoirs," U. S. D. A. Technical Bulletin No. 524, by Henry M. Eakin. "Conditions Influencing Erosion on the Boise River Watershed," U. S. D. A. Technical Bulletin No. 528, by F. G. Renner. "The Use of Bluegrass Sod in the Control of Soil Erosion," U. S. D. A. Farmers' Bulletin No. 1760, by R. E. Uhland. "Soil Defense in the Piedmont," U. S. D. A. Farmers' Bulletin 1767, by E. M. Rowalt.

"How to Build Up and Maintain the Virgin Fertility of Our Soils," Agr. Exp. Sta., Tuskegee Institute, Ala., Bul. 42, Oct. 1936, George W. Carver.

"Reclamation of White-Alkali Soils in the Imperial Valley," Agr. Exp. Sta., Berkeley, Calif., Bul. 601, July 1936, Edward E. Thomas.

"Soils in Relation to Fruit Growing in New York. Part IX. Tree Behavior on Important Soil Profiles in the Newfane-Olcott Area, Niagara County," Cornell Univ., Agr. Exp. Sta., Ithaca, N. Y., Bul. 653, July 1936, Joseph Oskamp.

"Absorption of Bacteria by Soils," Cornell Univ., Agr. Exp. Sta., Ithaca, N. Y., Memoir 197, Sept. 1936, T. C. Peele.

"Soils of Collin, Frio, Galveston, Midland, Potter, and Van Zandt Counties and the Trans-Pecos Area," Agr. Exp. Sta., College Station, Texas, Bul. 533, Oct. 1936, G. S. Fraps and J. F. Fudge.

"Subsoil Waters of Newlands, Nevada, Field Station," U. S. D. A., Washington, D. C., Tech. Bul. 533, Oct. 1936, Carl S. Scofield, C. Lloyd Moon, and Elmer W. Knight.

"The Effect of Thallium on Plant Growth," U. S. D. A., Washington, D. C., Cir. 409, Nov. 1936, E. E. Horn, Justus C. Ward, James C. Munch, and F. E. Garlough.

"Soil Survey of Lauderdale County, Alabama," U. S. D. A., Washington, D. C., Series 1931, No. 26, A. L. Gray, W. E. Tharp, M. E. Stephens, and L. G. Brackeen.

"Soil Survey of the Roswell Area, New Mexico," U. S. D. A., Washington, D. C., Series 1933, No. 2, W. G. Harper.

Crops

Flower lovers in many sections of the South and elsewhere will obtain a great deal of interesting information from Georgia Agricultural Experiment Station Circular 111, entitled "Dahlia Variety Test, 1936," by H. L. Cochran, D. D. Long, Norman LaMotte, and B. E. Phillips. Despite unfavorable weather during most of the growing season causing the loss of quite a few plants, results of the test were highly satisfactory as they revealed a number of newer and better varieties that may be successfully grown in Georgia. Brief descriptions of some 45 varieties and their characteristics are given in the circular. The important points relating to the best cultural practices, including the location and soil preparation most suited, recommended fertilizers and amounts to use, and setting of the plants or roots are explained. Pertinent questions one may ask on how to grow dahlias with best results are concisely answered. The authors tell us that the large dahlia is an expression of growth which is influenced by culture, fertilization, pruning, fighting insects and diseases, and above all, the choice of varieties. All efforts to grow big dahlias fail if the variety is naturally a small one. While the soil most adapted for growing dahlias is a sandy loam well supplied with humus, practically all types in this state are used successfully. Well-rotted manure may be applied around the base of the plant at the beginning of the blooming period with good results. An 8-4-6 or 10-4-7 (P-N-K) fertilizer broadcast at the rate of 100 pounds for a 50 ft. x 50 ft. plot and well worked into the soil in the early spring, or ¼ pound of fertilizer in a circle around the young plant once every 2 weeks after it starts growing, is recommended. There are some growers who apply some form of potash several times during the season. The circular states this should be done with care to prevent plant injury. Control measures for insects and diseases are prescribed as are other precautionary practices that lead to good dahlia growing.

"Forty-eighth Annual Report for Fiscal Year Ending June 30, 1936," Agr. Exp. Sta., Fayetteville, Ark., Bul. 337, Dan T. Gray, Director.

"Fifty-ninth Report of the Connecticut Agricultural Experiment Station for the Year 1935," and "Index to Annual Report," Agr. Exp. Sta., New Haven, Conn., Public Doc. 24.

"Annual Report of the Director for the Fiscal Year Ending June 30, 1935," Agr. Exp. Sta., Newark, Del., Bul. 203, Sept. 1936, C. A. McCue, Director.

"Annual Report for the Fiscal Year Ending June 30, 1936," Agr. Exp. Sta., Gainesville, Fla., Wilmon Newell, Director.

"Miscellaneous Tropical and Sub-tropical Florida Fruits," Agr. Ext. Serv., Gainesville, Fla., Bul. 85, Sept. 1936, Harold Mowry and L. R. Toy. Rev. by H. S. Wolfe.

"A Year's Progress in Solving Farm Problems of Illinois, 1934-35." Agr. Exp. Sta., Urbana, Ill., Forty-eighth Annual Report of H. W. Mumford, Director.

"Illinois Corn Performance Tests. . . . Results for 1935," Agr. Exp. Sta., Urbana, Ill., Bul. 427, Dec. 1936, G. H. Dungan, J. R. Holbert, W. J. Mumm, J. H. Bigger, and A. L. Lang.

"Illinois Corn Performance Tests. . . . Results for 1936," Agr. Exp. Sta., Urbana, Ill., Bul. 429, Jan. 1937, G. H. Dungan, J. R. Holbert, W. J. Mumm, J. H. Bigger, and A. L. Lang.

"Pasture Improvement and Management," Agr. Exp. Sta., Urbana, Ill., Cir. 465, Dec. 1936, W. L. Burlison, H. P. Rusk, and J. J. Pieper.

"Culture of Tung-oil Trees in Louisiana," Agr. Exp. Sta., Baton Rouge, La., Cir. 17, Nov. 1936, Julian C. Miller and W. D. Kimbrough.

"The 'Graduated Space' Method of Thinning Apples," Agr. Exp. Sta., East Lansing, Mich., Sp. Bul. 281, Feb. 1937, H. P. Gaston and G. L. Ricks.

"The Quarterly Bulletin," Agr. Exp. Sta., East Lansing, Mich., July 1936.

"Work of the Agricultural Experiment Station," Report of the Director for the Year

Ending June 30, 1935, Agr. Exp. Sta., Columbia, Mo., Bul. 370, Nov. 1936, F. B. Mumford, Director.

"The Agricultural Extension Service, Missouri College of Agriculture; Annual Report for 1936," Agr. Ext. Serv., Columbia, Mo., Cir. 357, Feb. 1937, F. B. Mumford, Director.

"Twenty-first Annual Report of the New Jersey State Department of Agriculture, July 1, 1935—June 30, 1936," St. Dept. of Agr., Trenton, N. J., Dec. 1936, William B. Duryee, Secretary.

"The Research and Educational Activities of the Station as Relating to Agricultural Trends in New Jersey," Agr. Exp. Sta., New Brunswick, N. J., Bul. 616, Nov. 1936, Jacob G. Lipman.

"Some Factors Influencing Growth and Fruit-setting in the Pepper (Capsicum Frutescens L.)," Cornell Univ., Agr. Exp. Sta., Ithaca, N. Y., Memoir 190, July 1936, H. L. Cochran.

"The Bimonthly Bulletin," Agr. Exp. Sta., Wooster, Ohio, Vol. XXII, No. 184, Jan.-Feb. 1937.

"Science Serving Agriculture, Report of Director for June 1, 1934 to June 30, 1936," Agr. Exp. Sta., Stillwater, Okla., C. P. Blackwell, Director.

"Growing Black Raspberries and Blackberries in Pennsylvania," Agr. Ext. Serv., State College, Pa., Cir. 170, Apr. 1936, J. Lupton Mecartney.

"Cherry Production in Pennsylvania," Agr. Ext. Serv., State College, Pa., Cir. 172, May 1936, J. U. Ruef.

"Red Raspberry Culture in Pennsylvania," Agr. Ext. Serv., State College, Pa., Cir. 178, Aug. 1936, John U. Ruef.

"Forty-ninth Annual Report of the South Carolina Experiment Station of Clemson Agricultural College for the Year Ended June 30, 1936," Agr. Exp. Sta., Clemson, S. C., Dec. 1936, H. P. Cooper, Director.

"Department of Agriculture—Immigration," Richmond, Va., Bul. 345, Feb. 1937.

"Service to Agriculture, Report of the West Virginia Agricultural Experiment Station for the Biennium Ending June 30, 1936," Agr. Exp. Sta., Morgantown, W. Va., Bul. 278, Dec. 1936, F. D. Fromme, Director.

"Tobacco Culture," U. S. D. A., Washington, D. C., Farmers' Bul. 571, Rev. Sept. 1936, W. W. Garner.

"Growing Sweet Corn for the Cannery," U. S. D. A., Washington, D. C., Farmers' Bul. 1634, Rev. Oct. 1936, J. H. Beattie.

"The Farm Garden," U. S. D. A., Washington, D. C., Farmers' Bul. 1673, Rev. Aug. 1936, J. H. Beattie and W. R. Beattie.

"White Clover," U. S. D. A., Washington, D. C., Leaflet No. 119, Oct. 1936, E. A. Hollowell.

Economics

Of special interest is the General Information Series of circulars recently published by the Agricultural Adjustment Administration. In G-64, issued January, 1937, Cotton Questions and Answers, the U. S. consumption of American cotton in 1935-1936 is given as about 6,221,000 or about 1,000,000 bales above the consumption in 1934-1935 and about 294,000 bales above the average consumption for the 10-year period 1923-1924 through 1932-1933. The lowest domestic consumption of American cotton was 4,700,000 bales in 1920-1921 and the highest was about 6,900,000 bales in 1926-1927.

The foreign consumption of American cotton in 1935-1936 was about 6,455,000 bales which was about 360,000 bales above the foreign consumption of 1934-1935 and 1,100,000 bales below the average for the 10-year period 1923-1924 through 1932-1933. The lowest consumption of American cotton by foreign countries was 5,400,000 bales in 1920-1921 and the highest was 8,900,000 bales both in the 1926-1927 and 1927-1928 seasons.

The world consumption of American cotton in 1935-1936 was about 12,676,000 bales. This is about 1,340,000 bales above the world consumption in 1934-1935 but still about 800,000 bales below the average for 1923-1924 to 1932-1933. The highest consumption was 15,800,000 bales in 1926-1927. The lowest occurred in 1920-1921 when only 10,000,000 bales were consumed.

The world consumption of foreign cotton in 1935-1936 was about 14,123,000 bales. Of special interest is the striking increase of 4,000,000 bales over the 10-year average, 1923-1924 through 1932-1933.

The world consumption of all cotton in 1935-1936 is estimated to be about 26,800,000 bales. This is about 1,600,000 bales above that in 1934-1935 and about 3,300,000 bales above the average for the 10-year period 1923-1924 through 1932-1933. In view of the upward trend in domes-

tic consumption, employment, payrolls, industrial production, farm income, etc., domestic consumption of American cotton this year may exceed that of last year. Factors which may influence the consumption of American cotton in foreign countries are general business conditions, expenditures for war supplies, availability and prices of American cotton in relation to supply and price of foreign cotton and competing fibres, and the trade arrangements including reciprocal agreements, foreign-exchange restrictions, and tariff. In the face of larger supplies of foreign cotton, increased output of competing fibres, and the continued shortage of foreign exchange in some countries, together with the tariff, and barter arrangements for the purchase of foreign cotton, the consumption of American cotton by foreign countries is likely to decrease in 1936-1937 as compared to 1935-1936. This decrease will tend to offset the expected increase in consumption in the United States. Producers of American cotton must remember that the whole crop must be sold in the world market at world prices. World consumption of all cotton in 1936-1937 will probably be larger than in 1935-1936. The world carry-over of American cotton on August 1, 1936, was about 7,000,000 bales. This is the smallest carry-over since the 6,300,000 bales in 1930-1931 season, and is 2,000,000 bales less than the August 1, 1935, carry-over but is almost 1,000,000 bales greater than the average carry-over for the 10-year period 1923-1924 through 1932-1933. It is, however, gratifying to note that this carry-over is 6,000,000 bales smaller than that in 1932.

The total farm value of the 1936-1937 cotton crop in the United States will be about $970,000,000, with a purchasing power about $200,000,000 greater than the 1930-1931 crop and about $200,000,000 less than the average between 1925-1929.

The American cotton producers harvested about 30,054,000 acres in 1936-1937. The average acreage harvested over the 10-year period 1923-1924 through 1932-1933 was 40,500,000. The total base acreage for cotton in the United States in 1936-1937 was 44,500,000 acres and about 75 per cent of this acreage was under the 1936 Agricultural Conservation Program. A crop for the coming season of about 12,000,000 bales will be sufficient to produce a supply equal to the average 18,470,000 for the 10-year period 1921-1922 through 1930-1931. It is estimated that 28,680,000 acres, yielding 200 pounds per acre will be sufficient to produce this requirement. Under normal conditions the required crop for the coming season can be produced on about 65 to 75 per cent of the base acreage of 44,500,000 acres for the United States.

"Economic Digest," Conn. St. Col., Storrs, Conn., No. 66, Jan. 1937.

"Soybean Costs and Production Practices," Agr. Exp. Sta., Urbana, Ill., Bul. 428, Dec. 1936, *R. C. Ross.*

"Some Characteristics of Cultivatable Land in the Sugar Cane Area of Louisiana," Agr. Exp. Sta., Baton Rouge, La., Bul. 280, Oct. 1936, *R. J. Saville and A. L. Dugas.*

"An Analysis of Agriculture on the Valier Irrigation Project," Agr. Exp. Sta., Bozeman, Mont., Bul. 330, Dec. 1936, *P. L. Slagsvold.*

"Determining the Tonnage of Hay in Long Stacks and Round Stacks," Agr. Exp. Sta., Reno, Nev., Bul. 143, Sept. 1936, *F. B. Headley.*

"The New York State 1937 Agricultural Outlook," Cornell Univ., Agr. Ext. Serv., Ithaca, N. Y., Bul. 302, Dec. 1936.

"An Economic Study of Land Utilization in Chenango County, New York," Cornell Univ., Agr. Exp. Sta., Ithaca, N. Y., Bul. 654, Aug. 1936, *H. S. Tyler.*

"Farm Economics," Col. of Agr., Cornell Univ., Ithaca, N. Y., No. 99, Feb. 1937.

"The Farm Outlook for 1937," U. S. D. A., Washington, D. C., Misc. Pub. 255, Dec. 1936.

"Federal Seed-loan Financing and Its Relation to Agricultural Rehabilitation and Land Use," U. S. D. A., Washington, D. C., Tech. Bul. 539, Oct. 1936, *Norman J. Wall.*

"Flue-cured Tobacco," U. S. D. A., AAA, Washington, D. C., G-63, Jan. 1937.

"A Graphic Summary of Farm Tenure," U. S. D. A., Washington, D. C., Misc. Pub. 261, Dec. 1936, *H. O. Turner.*

A Winning Campaign Against Wheat Smut

(*From page* 20)

varieties. It is evident that no one variety is suitable for the entire United States, even if it is smut resistant. D. E. Stephens, of the Moro Experiment Station in Oregon, was one of the first workers on resistant varieties. He gathered all of the known wheats from all over the world, smutted them, and isolated dozens of smut-resistant kinds. Most of these, of course, were of no value for the arid Columbia River Basin, but out of these trials he found two strains of Turkey Red which were nearly immune. He called them Oro and Rio. Oro has turned out well in many places in the Middle West.

The Washington Experiment Station has been working on smut-resistant wheats for many years. Their attack was different. They found a variety which was highly resistant, crossed it with many of the varieties adapted to eastern Washington, and developed two new white wheats, both having the adaptability to the region of the one parent and the smut resistance of the other. They were called Albit and Ridit.

But in the meantime the geneticists and plant pathologists had discovered something which changed the whole campaign against smut. They found that smut, as well as wheat, had varieties, and a wheat considered immune in one community would be highly susceptible in another place where a different strain of smut was rampant. So this started the work all over again.

With this handicap the new varieties have not appeared so fast as it was hoped they would. After years of work in crossing and selecting, the station worker would finally think he had the ideal wheat only to find in field trials that it had some other bad characteristic, perhaps poor milling quality, or maybe susceptibility to rust or freezing injury, or something else.

But gradually the good resistant wheats are emerging. In the state of Washington, Hymar, the result of a cross between Hybrid 128 and Martin is now being distributed to farmers. About 1,000 acres were planted in Washington the fall of 1935. It is a white club wheat. Its main growing area would seem to be the sections of Washington and Idaho which have 18 inches of rain or more. It is rather late for the lower elevation, drier areas.

In eastern Oregon, Rex, another wheat developed by Mr. Stephens, is something of a sensation. It was planted on 15,000 acres in the fall of 1935. It is a very early white wheat, stiff strawed, extremely resistant to

shattering, and a high yielder all over the Columbia Basin. It is a cross between White Odessa and Hard Federation. It is a true winter wheat with a harder kernel than most of the smut-resistant wheats.

The Nebraska station has developed a highly smut-resistant Turkey Red wheat but so far it has not been outstanding in yield like Rex and Hymar. Oregon farmers are very enthusiastic about Rex. It made authenticated yields of more than 60 bushels per acre under ordinary field conditions in 1935.

The Montana experiment station has distributed Yogo, another smut-resistant Turkey Red wheat. Utah has a variety called Relief. All of the western experiment stations are hot on the trail of additional varieties. Unfortunately, the varieties like Rex, which are high yielding and have other good qualities, are not resistant to rust. The wheat breeders still have work to do.

Prevent Blackening of Irish Potatoes

(*From page* 16)

by several rarer elements in addition to complete fertilizer remained white after cooking." The several issues involved in these findings are being subjected to further investigation.

According to authorities at the University of Wisconsin, blackening appears to be associated to a limited extent with higher percentages of nitrogen in the dry matter. In this phase of the problem, a considerable number of both normal and abnormal samples were analyzed by Dr. Tottingham and his assistants. They found that the average percentage of nitrogen in the dry matter of peeled potatoes was 1.69 for potatoes which remained white while the average per cent of nitrogen was 1.87 for the tubers that blackened. Dr. Tottingham expressed the view that the higher nitrogen content may be a factor associated with other conditions to cause blackening of some potato crops.

Immaturity of the potato vines at the time of harvesting is not a primary factor in the blackening of potatoes after cooking. The research workers made a limited survey of tubers dug two or three weeks before the maturity of the vines. Results indicated that the abnormal condition was due to protein digestion occurring after ripening.

Storage at high temperature and with greatly curtailed ventilation does not influence the occurrence of discoloration. Reference has been made to advanced stages of sprouting causing blackening after cooking. That condition, however, is due to the breaking of dormancy rather than to unfavorable factors in the storage conditions, according to Dr. Tottingham.

In determining the relation of storage conditions, choice samples were obtained from the 1934 crop of Russet Burbank and other varieties most extensively grown in Wisconsin. These varieties were supplemented from field plots of the Rural New Yorker which had been produced either from blackening "seed stock" or on a deficient supply of soil potash. Samples of each variety were stored in burlap bags and in paraffined cartons. In addition samples of each were stored at temperatures of about 70 degrees F. to 39 degrees F.

Both raw and boiled samples of the several tuber stocks were analyzed in November and similar examinations made in January and March. The study was repeated on a somewhat smaller scale in 1935. The results obtained, however, indicated that neither storage, temperature, nor ventilation is a primary factor affecting the blackening after cooking.

A summation of results of experi-

ments at the University of Wisconsin on the causes of blackening has led to the following conclusions:

1. The blackening of cooked potatoes does not appear to be associated with transmissible pathological conditions.

2. In 1935, when the soil content of available potash was less than 200 pounds per acre, potatoes of several varieties blackened after cooking; but this response was negligible when the supply approached 400 pounds. Samples showing large proportions of blackening contained an average of less than 1.8 per cent of potash in the dry matter, while the average content was above this level in the normal tuber.

3. This abnormality appears to be associated to a limited degree with higher percentages of nitrogen in the dry matter of the tuber.

4. Immaturity of the plant is not a primary factor in the blackening of the potatoes.

5. Storage at high temperatures with greatly curtailed ventilation does not induce the blackening response significantly.

In concluding the discussion of the problem as a whole, Dr. Tottingham made the following statement:

"A lack of potash in the tuber leads after harvesting to an accumulation of free amino acids. These should be more completely formed into protein. One of two amino acids react with oxygen from the air under the influence of enzymes. They thus form substances which change spontaneously to the blue and black pigments after cooking. This change in the stored potatoes appears to be aggravated by the lack of potash.

Make Potash Available

"This combination of circumstances attending the lack of sufficient available potash is one of the critical factors in potato production. It is not entirely met, however, by supplying large quantities of potash to the soil. On some soil types and in dry seasons the potash does not remain available.

"Apparently, part of the efficiency of irrigation in producing high quality potatoes should be attributed to its favorable effect in supplying to the plant sufficient potash and other soil elements. It is possible that a more complete remedy for discoloration after cooking may be found only by including other mineral elements with potassium in the fertilizer applied."

The Agricultural Future of Puerto Rico

(*From page* 22)

densely populated areas on the earth, having 501 persons per square mile, one to every 1.42 acres, one to every 0.79 acre of improved land, and one to every 0.49 acre of cultivated land. The population increased 18.7 per cent from 1920 to 1930. The people speak both English and Spanish and uphold the ideals and culture of both nations. They are as familiar with Shakespeare as with Cervantes.

The people love their homeland, and rightly so. While some have located in New York City and certain other parts of the United States, relatively few leave the Island to seek a living elsewhere. With justifiable pride they call their homeland "The Paradise of the Atlantic."

Usually tropical soils of varying degrees of elevation are eroded to a marked extent. This is not true in Puerto Rico. In the tobacco areas of Caguas, Cayey, Comerio, Corozal,

Cidra, Ciales, and elsewhere, soils cultivated are on slopes of 45 degrees or more, yet in very few instances does erosion occur. This is due, in large measure, to the nature of the soil and to its comparative freedom from quartz grains.

Variety of Soils

There is a wide variety of soil types due to rough topography, native vegetation and its uneven distribution, the unusual amount of precipitation, and the varying nature of the parent material. In the northern coastal plain the soils are redder, more matured, and more leached of soluble salts than in many other areas.

It would be difficult to find more fertile soils, or soils more suitable for cultivation, than those of the lowlands. These are to a considerable extent alluvial in origin. It is in this locality that the greatest export crop of the Island, sugar cane, is grown. Sugar cane also is grown on soils of slightly higher elevation, where tobacco was formerly grown. This further reduces the acreage which is devoted to tobacco, which is the second largest export crop.

The topography of the soil renders it difficult to sterilize seed-beds properly, although the method now used has proved markedly efficient. Moreover, the soils are rather difficult to cultivate on account of their steepness.

Hurricanes (from Hurican, a Carib Deity) are matters for concern, especially from the standpoint of the destruction of curing sheds; this presents an almost insurmountable difficulty.

Soil Fertility

The greatest problem of the tobacco grower, however, is that of the fertility of the soil. Because of the relatively high temperature and the heavy rainfall, the tobacco soils have been depleted of available nutrients to a considerable extent. This holds true for other soils on the Island as well, with the result that in 1935 there were imported 70,783 tons of fertilizer, valued at $1,434,415. Much of this was used for fertilizing tobacco.

Because of the favorable conditions for nitrogen fixation, these soils contain a considerable quantity of this element. A 6-7-8 fertilizer for tobacco is used in most cases. This appears to have too narrow a ratio for cigar-leaf tobacco; a higher unitage of potash would doubtless prove as beneficial here as it has in other localities where cigar-leaf tobacco is grown.

The Department of Agriculture and Commerce, headed by Commissioner R. Menendez Rámos, who has a well-trained staff, has established a Tobacco Institute, in which the most important phases of the tobacco industry of Puerto Rico are studied. Dr. J. A. B. Nolla, Assistant Commissioner of Agriculture and Commerce, has played a very active and notable rôle in tobacco research in recent years.

At the Insular Experiment Station, studies of Puerto Rican soils are now being made. This work is under the supervision of Director López Domínguez, who has a staff of outstanding scientists, among whom may be mentioned Dr. J. A. Bonnet, who is recognized as an authority on tropical soils.

Research Is Necessary

The value of the research indicated cannot be over-emphasized. Puerto Rico is essentially an agricultural area and has been so since the early days of colonization. While considerable attention has been given in recent years to the processing of agricultural products, to manufacturing, fishing, and the mineral industries; nevertheless, the future of Puerto Rico seems to depend largely on the sugar, tobacco, and other agricultural interests. The rise or fall in the value of agricultural export crops is very closely associated with the well-being of this agricultural people.

Will Potash Benefit Your Apple Orchard?

(*From page* 14)

But the conditions here are most unusual. No sane farmer would handle his soil as these plots have been managed and we hesitate to draw conclusions from this test for application to general orchard practice.

In an orchard of McIntosh and Baldwin trees planted in 1912 we have a comparison of nitrogen and nitrogen plus potash on one plot which is in sod. The two varieties are interplanted. There is another comparison of nitrogen alone on one plot with a complete fertilizer on two other plots all under cultivation.

Table I shows the yields of the two varieties by 2-year periods in pounds per tree. The grouping into 2-year periods is to overcome the irregularity due to biennial bearing. The sod plots in the first part of the table were treated alike for the first 6 years receiving nitrate of soda, 300 pounds per acre. Beginning in 1927 one of the plots has also had sulphate of potash at the rate of 150 pounds per acre. On face of the returns McIntosh has yielded better since the potash fertilizer has been used, but it should be noted that this plot produced better from the start. There is no indication that Baldwin has yielded any better since the potash applications began. It seems doubtful that the two varieties really will respond differently to potash but it may be so.

In another orchard of Wealthy trees planted in 1915 and given uniform treatment up to 1927 we have compared nitrogen alone, nitrogen and potash, phosphorous and potash, and a complete fertilizer. Each treatment is replicated four times and there are normally five trees on each plot. Four plots have only three trees and a few trees are missing. Thus each treatment is applied to a total of 18 trees or nearly that number.

Here there is a little more consist-

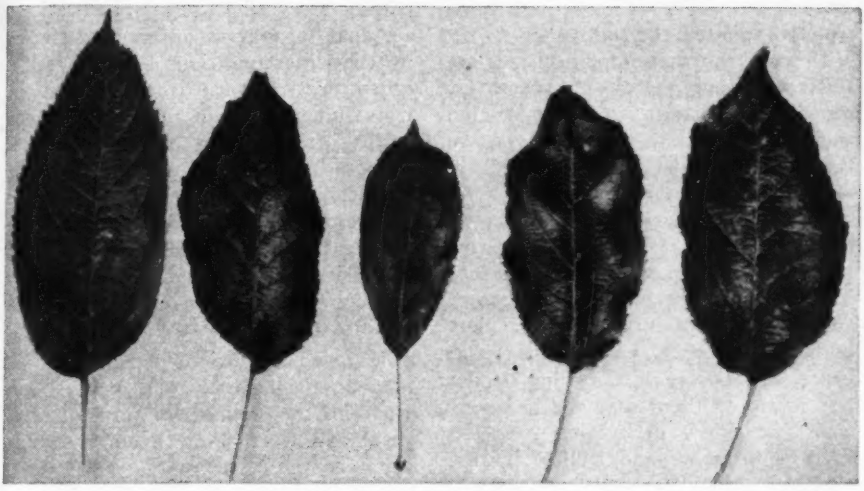
TABLE I. YIELDS OF THE TWO VARIETIES BY TWO-YEAR PERIODS IN POUNDS PER TREE.

SOD PLOTS

1921 1922	1923 1924	1925 1926		1927 1928	1929 1930	1931 1932	1933 1934	1935 1936
Uniform Treatment			McIntosh	Differential Treatment				
461	574	327	No potash	314	656	473	533	844
559	764	483	Potash	680	1003	1064	1019	1121
			Baldwin					
331	553	662	No potash	292	887	183	932	739
354	482	567	Potash	371	737	145	862	664

CULTIVATED PLOTS

1921 1922	1923 1924	1925 1926	1927 1928	1929 1930		1931 1932	1933 1934	1935 1936
Uniform Treatment					McIntosh	Differential Treatment after 1929		
473	254	237	601	938	Nitrogen	845	517	837
34	418	383	506	679	Complete	724	1171	1211
263	426	547	532	648	Complete	537	1266	1034
					Baldwin			
179	66	54	600	923	Nitrogen	692	477	166
11	170	434	841	764	Complete	272	1485	1021
82	272	674	345	725	Complete	358	928	250



The three leaves in the center show "edge burn" due to potash deficiency. While this symptom often accompanies severe potash shortage, it may appear due to other causes. Dry weather is a factor in this condition.

ent evidence of better yields when potash or potash and phosphorus are added to nitrogen in the orchard fertilizer. The behavior of the trees on the nitrogen plots is similar to that of those on other plots where nitrogen has been applied to trees suffering from lack of this element. They respond quickly with increased yields, but this increase is not well maintained. Whether the larger yield of the complete fertilizer plot in the last two years will be maintained in future years remains to be determined.

While these results indicate that in our own orchards the addition of potash to nitrogen has given increased yields with McIntosh and Wealthy, they should be taken with reservations as applying to orchards in general.

We have used the Thornton test for potash in the leaf petiole in an effort to determine if trees were deficient in potash. Results from this test correspond roughly with determinations made by the usual chemical method. While this test shows much variation in individual trees, it indicates more potash in trees that have been fertilized with potash for several years than in those fertilized with nitrogen only. We have tested leaves from many orchards in Massachusetts and have found only a few, less than 10 per cent, that seem to be dangerously low in potash. While we are not yet ready to recommend the general use of potash-carrying fertilizers in our orchards, we feel that this element will be used more commonly in the future than it has in recent years, especially as orchards become

TABLE II. YIELDS IN ORCHARD OF WEALTHY TREES.

1921 1922	1923 1924	1925 1926		1927 1928	1929 1930	1931 1932	1933 1934	1935 1936
Uniform Treatment				Differential Treatment				
12	59	90	Complete	192	261	352	354	497
14	46	227	Nit. Pot.	235	258	358	362	402
18	40	121	Nitrogen	354	246	268	265	274
10	53	94	Phos. Pot.	178	217	251	217	257
17	38	110	Potash	221	222	208	157	236

mature and the roots have more completely exploited the soil.

If it is true that some orchards are suffering from a lack of potash, it becomes important to know which they are. They are more likely to be those on dry, shallow soils, especially soils that have a large portion of sand or gravel. The symptoms observed here are somewhat like those of nitrogen starvation but the leaves do not show as much tendency to become yellowish. Many of the lateral leaf buds fail to start, leaving the twigs bare. Shoots are apt to be slender and many of them may die in severe cases especially in weaker varieties such as Wagener and Yellow Transparent.

Tip burn of the leaves is generally regarded as a distinctive symptom of potash starvation. Our observations are that it appears on most varieties by the time conditions become acute. However, tip burn is often seen in trees suffering from malnutrition resulting from causes other than lack of potash. Perhaps the most valuable symptom is the failure of the trees to respond to increased nitrogen fertilization. In potash-deficient trees, increasing the nitrogen supply makes the condition of the trees worse instead of better.

If these conditions are present it may be a good idea to try potash on a part of the orchard for three or four years and see if growth and production are increased.

Pictures in this article by the courtesy of the Horticultural Experiment Station, Vineland, Ontario.

New Fertilizers for Ontario Tobacco

(*From page* 19)

application under average conditions is 10 tons of barnyard manure per acre.

In support of these recommendations, a few of the burley fertilizer tests are summarized in table 2. This table illustrates the responses from nitrogen, phosphoric acid, and potash on a sandy-loam soil, and the response from phosphoric acid on a clay-loam soil. This table clearly shows the difference in response from phosphoric acid on these sandy-loam and clay-

Quality of tobacco may be definitely affected by the fertilizer treatment even when differences in the field growth are very small. General view of the flue-cured fertilizer plots at the Harrow Station.

loam soils. The response from potash was not nearly as marked on clay-loam soil. Each figure represents an average of four treatments conducted over a 4-year period. The 4-year averages, therefore, represent 16 repetitions of each test.

TABLE 2. BURLEY TOBACCO FERTILIZER TESTS BY THE HARROW STATION, 1929-32 INCLUSIVE.

Fertilizer Formula	Acre Yield, Lbs.	Value, ¢ per Pound	Value, $ per Acre
Varying Nitrogen (Sandy-loam soil)			
4-8-12	1,357	16.8	227.98
6-8-12	1,462	17.1	250.00
8-8-12	1,454	16.9	245.73
10-8-12	1,492	16.3	243.20
Varying Phosphoric Acid (Sandy-loam soil)			
4-0-12	1,131	13.5	152.69
4-4-12	1,364	15.8	215.51
4-8-12	1,492	16.2	241.70
4-16-12	1,481	16.2	239.92
Varying Potash (Sandy-loam soil)			
4-8-0	1,313	12.3	161.50
4-8-6	1,432	15.0	214.80
4-8-12	1,470	15.6	229.32
4-8-24	1,528	17.8	271.98
Varying Phosphoric Acid (Clay-loam soil)			
4-4-6	1,397	16.6	231.90
4-8-6	1,411	18.2	256.80
4-16-6	1,502	18.9	283.88

The fertilizer tests conducted at Harrow over a period of years in which no manure was applied indicated that a fertilizer high in nitrogen and potash would produce the best dark tobacco. Recent experiments conducted in one of the best dark tobacco districts show that where heavy applications of barnyard manure are made, less nitrogen and potash are required. Where heavy manuring is practised, a 4-8-6 fertilizer is recommended at the rate of 500 to 800 pounds per acre. However, experiments would indicate that where manure is not applied or where only a light application is made, the potash and possibly the nitrogen could be increased to advantage. Likewise, where the potash level in the soil is low, more potash could be used to advantage. A 4-8-10 fertilizer is recommended in such cases.

The nitrogen portion of the fertilizer is usually supplied from several materials. Experiments definitely indicate that at least a quarter of the nitrogen should be supplied from plant or animal organic source, such as from dried blood, high-grade tankage, soybean meal, or cottonseed meal. This portion of the nitrogen becomes available to the plant at a rather slow rate. These tests also show that nitrate of soda is an exceptionally good source of nitrogen.

The recommendation made on the basis of these results is that at least one-quarter of the nitrogen be derived from plant or animal organic sources as listed above, that one-quarter of the nitrogen be derived from nitrate of soda, and that the remainder of the nitrogen be supplied from other standard water-soluble materials. This general recommendation is made for all three types of tobacco in Ontario, as the various tests show that a source of nitrogen that is good for flue-cured tobacco is equally good for burley.

It is recommended that the phosphoric acid be supplied from superphosphate or other easily soluble phosphates.

Source of Potash

The source of potash is also important. While experiments have proved that a tobacco fertilizer is better if a portion of the potash is derived from muriate of potash, the amount of the potash supplied in this form must be limited to protect the burning qualities in the cured leaf. Therefore, a fertilizer is better if the potash is derived from more than one source. The general recommendation for all three types of tobacco is that potash be derived from sulphate of potash and muriate of potash or a portion from sulphate of potash magnesia or other sources of water-soluble potash. It is further recommended that

care be taken not to include a larger proportion of muriate of potash than will bring the chlorine above 2 per cent of the total mixture.

SUMMARY OF FERTILIZER MIXTURE RECOMMENDED

(1) *Flue-cured Tobacco*

A. Use a 2-10-8 fertilizer under average conditions.

B. Where potash levels in the soil are low use a 2-10-12 mixture.

C. A 2-12-6 may be used to advantage where slow maturity has been experienced, particularly on the low-lying soils.

(2) *Burley Tobacco*

A. Use a 4-8-10 fertilizer on sandy-loam and gravelly-loam soils.

B. Use a 2-12-6 fertilizer on clay-loam soils.

C. A 4-12-10 or a 2-12-10, depending on the nitrogen levels in the soil, may be used to advantage on some of the heavier gravelly-loam and intermediate-loam soils.

(3) *Dark Tobacco*

A. Use a 4-8-6 fertilizer where heavy manuring is practised.

B. A 4-8-10 fertilizer may be used to advantage if the potash levels in the soil are low and light manuring is practised.

Alabama's Forward March In Fertilizer Practices

(*From page* 12)

"The same amount of plant food as contained in a 600-pound application of 6-8-4 may also be supplied by an application of 600 pounds of 4-8-4 and a side application of 75 pounds per acre of nitrate of soda or its equivalent.

"Many farmers may wish to buy the separate fertilizer ingredients and mix these materials on the farm in such proportion as to require no side-dressing. If this is the case, the following materials should be mixed and applied per acre: 175 pounds sulphate of ammonia or its equivalent (this amount of sulphate of ammonia would require about 200 pounds of limestone which should be included in the mixture, 300 pounds of superphosphate, and 48 pounds of muriate of potash. This mixture would weigh 723 pounds (including the limestone) and would supply exactly the same amount of nitrogen, phosphoric acid, and potash as would be supplied by the use of 600 pounds per acre of a 6-8-4 fertilizer. The above mixture is satisfactory on light or heavy-textured soils.

"In the event that a farmer has a fairly heavy soil and wants to use nitrate of soda or its equivalent instead of sulfate of ammonia and the limestone, the following materials should be mixed and applied per acre: 255 pounds of nitrate of soda or its equivalent, 300 pounds of superphosphate, and 48 pounds of muriate of potash. This mixture would weigh 573 pounds and would be equivalent to 600 pounds of a 6-8-4 fertilizer in every respect. If a farmer does not wish to use fertilizer at this rate per acre, the mixtures given above may be applied on the desired number of acres.

At the present time Alabama farmers are being advised by farm leaders to fertilize their cotton as recommended in the above statements by Dean Funchess, and indications are that a larger tonnage of 6-8-4 will be used in the State in 1937 than was used the past year when more than 100,000 tons were applied.

Better Crops of Better Quality

(*From page* 10)

was approximately one and one-half times as great on the plots where potash was added as it was on those where potash was not added. This high pulling resistance of plants on potash treated plots was evidently the effect of better anchorage, which in turn was due to better root systems produced by applications of potash. In producing good quality corn, this factor is of great importance.

It has been shown quantitatively and qualitatively that potash, used alone or in combinations, when compared to fertilizers not containing potash, produced higher yields of crops of better quality, brought about better harvesting conditions, and increased the ratio of grain to stalk. No graphs or tables have been shown to indicate the increases due to potash for the shelling percentage of corn, weight of grains, and weight per bushel, but in every case these qualitative factors were distinctly increased by the additions of potash to the fertilizer mixture.

Eliminates Firing

A photograph shows the effects of potash on corn leaves. Potassium-deficient soils cause the tissues around the margins and between the veins of the corn leaves to die prematurely. On the other hand, plants grown on plots receiving applications of either manure or potash were healthy and showed no marginal dead tissues of "firing" of the leaves. A strong relationship exists between "firing" of corn leaves and the small quantities of potassium in the cell sap.

The fertilizer recommendations on these clay-loam soils vary with the farming and cropping systems as well as the productivity of the soil. It is necessary to return at least as much plant food to the soil as is removed by crops, if the fertility of the soil is to be maintained.

In a common rotation of corn, wheat, and clover a large amount of plant food is removed. A 60-bushel corn crop with 2 tons of fodder removes 83 pounds nitrogen, 40 pounds phosphoric acid, and 73 pounds potash. A 25-bushel wheat crop with 1 ton of straw removes 38 pounds nitrogen, 26 pounds phosphoric acid, and 23 pounds potash. A 2-ton crop of clover hay removes 82 pounds nitrogen, 16 pounds phosphoric acid, and 65 pounds potash. This means that in the 3-year period of this rotation 203 pounds nitrogen, 82 pounds of phosphoric acid, and 161 pounds of potash are removed from the soil.

It would require 1,270 pounds of nitrate of soda, 512 pounds of 16 per cent superphosphate, and 322 pounds of muriate of potash to supply this amount of plant food. The clover, however, if inoculated, will normally gather enough nitrogen from the air to equal that removed by the crops, especially if the second crop of clover is returned to the soil. If the produce from this land is fed and the manure carefully preserved and returned to the land, at least half

Potash starvation symptoms on clover and alfalfa are white spots which appear around the border of the leaf and invade toward the center. The border finally turns yellow, dries up, and turns under.

of the mineral matter will be returned to the soil. The net loss of plant food removed by the crops in the 3-year rotation will then be the equivalent of about 250 pounds of superphosphate and 160 pounds of muriate of potash. Therefore, the application of about 200 pounds of 16 per cent superphosphate and 80 to 100 pounds of muriate of potash per acre, or equivalent amounts of these plant foods in the form of ready-mixed fertilizers, under corn and wheat should replenish the plant food removed by the crops and add enough to make up for erosion and leaching losses. If no manure is returned to the soil it will require at least twice the amount of fertilizer as where manure is returned to the soil, in order to maintain the plant-food balance.

Where good rotations are maintained, and by practicing the above fertilizing systems, high-yielding crops will be secured and productivity of the soil will be maintained.

The L. G. Jubilee

(*From page 5*)

igan; but develop a family of cattle of high production and low variability of production, and they will make good from Storrs to Berkeley. Yet against this argument I muster one self-evident truth for the defense of the duplicators. You never have and never will corral all the potential Mendels and Darwins under the roof of any one state institution. If you did, the legislature would balk at the eleventh hour and the whole enterprise would go to the bow-wows! And then, of course, you have the ancient policy of competitive effort, which has turned out more American successes than isolated subsidy. Surely the contest spirit in colleges should not be left entirely to the stadiums!

Consequently, in the matter of duplicated effort herein, I find myself in exactly the same diplomatic position with so many polished professors—astride the w.-k. fence!

Land-granters must not live so much to their own curriculums and corridors that they forget the duty owed by the states to elementary education. No system of universal learning to which these institutions are dedicated can succeed fully by largesse at the top and laxity at the bottom.

With the passing of most of their original doweries, the land-grant colleges must depend on at least three fundamentals for future support, namely: a public appreciation of culture, ability of the people to turn training into living, and the broadening of economic and social opportunity as a safeguard for national welfare. That is, the land-grant teacher stands like a modern auto finisher who can only be sure of his job of polishing fenders and adjusting headlights just so long as the stream of raw ore pours into the smelters and rolling mills. Lectures are no good without listeners, and libraries have no value if left to mice and silver-fish.

To be sure, numerous land-grant grads have switched off the main line to the branch track of vocational, part-time, night-school teaching; but probably it has been no spiritual loss to them. If you doubt it, stand in a corner out of the rush from seven to nine on five nights per week and see work-a-day America return to its books!

Nine out of ten of these eager night-crammers found out the truths which really make education precious—earlier denial or frustration on the one hand, and subsequent proof of their inferiority without it. Vocational courses outside of land-grant colleges deserve land-grant endorse-

ment, if for no other reason than because they are also willing to tackle a job which the deans rapidly abandon—the doctoring of the dullard and the conquest of the "con."

AND mark you, moreover, no land-granter may remain satisfied with creating a few "B A's" in the corn-belt, while little district schools are left pinched and penurious on meagerly assessed valuations. Don't forget that famous Iowa supervisor's so-called "ratio of 1-2-3." It stands for the facts as to agricultural conditions, namely, the farmers get one-tenth of the national income, farm women are two-tenths of the nation's women, while they raise three-tenths of the country's children. We doubt much whether as things exist today those three-tenths of our children living in rural school areas obtain anywhere near the rightful share of educational opportunity. Our anniversary program would be incomplete without acknowledgment that not all the barriers to learning have been cut away by the land-grant act alone.

We must not overlook the original principle of higher education in this country, and the careers to which its scattered recipients were dedicated. Our simple ancestors, devoid of classics themselves, insisted on being well-born, well-married, and well-harried. They sought a Greco-Roman background in their physicians, their ministers, and their lawyers. Three noble professions were open to graduates in those days, whereas more than three thousand occupations can be counted up as fields for educated enterprise today. That the research achievements of the colleges have created a major share of those new positions is also a fact.

Charters granted to the colleges of agriculture and mechanic arts dedicated them to the equalization of opportunity to get knowledge for better production as a means of subsistence and comfort. To be sure, culture was provided for, and the land-grant colleges also taught purely abstract subjects, affording a haven for the scholars of a contemplative, temperamental nature.

In the realms of art, literature, pure science, and music the results have been sustaining and inspiring; but we cannot deny that the real purpose of these institutions was to train practical folks for the work-a-day world and to appreciate its beauties and its horizons.

In the production of better tools and finer methods, the land-grant colleges have done wonders for us all, but in envisioning and developing a safer national economy, with fewer bumps and breaks, only a few minor chords have arisen from their cloisters. I hasten to add this saving afterthought—that during all history the land-granters have tried to provide just about what the mass demanded or what the world would accept for the time being. The lust for temporary expediency and material success animating the fast-growing western hemisphere probably set the stage for the land-grant show.

FOR example, in listing the accomplishments of its graduates, one writer for the colleges shows that the directors of the largest industrial laboratories, the presidents of six or more top utilities and manufacturing concerns, and the heads of five or six largest railway companies are graduates of land-grant colleges. But they, too, and more bitterly and directly the farmer-graduates within my personal ken, have nursed the hope of a richer type of human nourishment to come from the land-grant colleges in the wake of the recent depression.

That the land-granters will fulfill expectations in this regard, I have not the slightest doubt. In every crisis facing the country they have done patriotic duty. In the World War 100,000 graduates, including 30,000 officers, served in the army and navy.

Enhanced food production and the speeding up of emergency defense industries kept every land-grant campus humming day and night.

LATER, when we came smack up against the unseen enemy of despair and hunger, unemployment and riot, a few brain-trusters packed their bags and hied to Washington, leaving their fellows a divided camp behind them. To some extent they remain divided today on the issue of the hour, an issue which makes the old go-easy and slip-shod methods of study and extension seem decadent by comparison.

And believe me, the choice is no easy and simple one! We have seen the old adage, "haste makes waste," come true in many state and federal schemes and enterprises set going on the highest of motives. We know that one rule or one system cannot work for all the varied throngs of humanity who look toward some legislative hall for succor. But to veteran land-granters such perplexities and apparent contradictions are not discouraging. For they admit that the same method of trial and error has achieved all the wonders which thus far they have presented to the materialistic world.

Happily a compromise is easy. We must retain in our worthy faculties those wheel-horses who pulled us out of the mud of inefficient production, wasteful marketing, weak and eroded soils, inferior livestock, and who taught diversified agriculture. No safely permanent type of farming can ever be built or maintained on any method which encourages laxity. The self-sufficing, production-improvement group need not hang crepe on their classroom doors or shun the crowded institute halls. Yet they must be tolerant before the new order and be willing to move over and give elbow room to the cosmopolitan, social-minded fellowship whose presence on the land-grant staffs presages another inevitable trend toward the popular will.

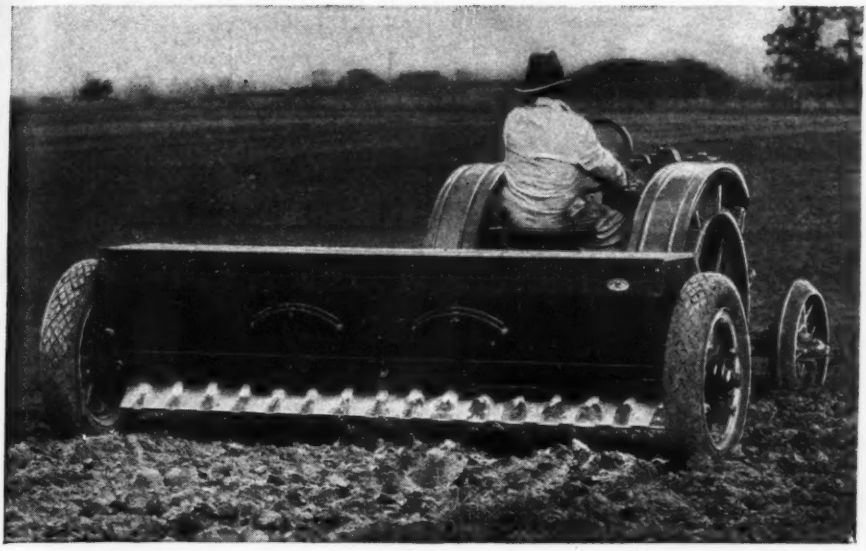
No more auspicious year could be realized in which to find ourselves celebrating the diamond jubilee of the useful land-grant institutions. We have passed beyond the worst aspects of a financial dilemma. We have found millions of farmers able to unite for one purpose in a manner seldom hoped for by the wildest optimists. We have suffered slight court setbacks in realizing that objective, but out of the ashes has come a broader policy of soil renewal and land fertility—and hopes are aroused for other needful correctives in rural social economy. Our physical disasters of sun and flood have tempered our enthusiasm with conservatism and caution. The farmer and the mechanic plan to work together hereafter for a common national stability and security, under the far-flung banner of the institutions to which both look for comfort and advice.

LET me suggest that this summer a general observance of the seventy-fifth anniversary of the Morrill law and the fiftieth milestone of the Hatch experiment station act be a prime objective of every leading college in this category. And if perchance we journey to Washington betimes may we find testimonials and displays of the origin and growth of the United States Department of Agriculture. It also has a diamond jubilee to celebrate this spring.

I intend to recommend this to the Honorable Secretary himself! He is sure to sit up and take notice of anything I have to offer anyhow! Besides, there is nothing in it contrary to the constitution, which puts me in a class of suggesters he will be particularly happy to oblige!

Teacher: "Here's a little example in mental arithmetic. How old would a person be who was born in 1898?"

Pupil: "Was it a man or a woman, teacher?"



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Sunshine, rain and the proper soil; these three help to determine crop success. We have no control of sunshine, and except through expensive irrigation systems, little control of moisture. But, thanks to modern chemistry, we can control soil fertility. All that is required is the adequate use of complete fertilizer containing the proper amount of Potash, and applying the number of pounds per acre as recommended by your State Experiment Station.

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OFF THE RECORD

He was applying for County Relief and the young lady official was filling out the customary form.

"Do you owe any back house rent?" she asked.

"We ain't had no backhouse for years," he replied with great dignity. "We got modern plumbing."

Customer: "Have you a book called —'Man, the Master of Women?' "

Salesgirl: "The fiction department is on the other side, sir."

ENGINEERING FEAT

"Did you know, dear, that that tunnel we just passed through was 2 miles long and cost $12,000,000?" asked the young man of his sweet heart.

"Oh really?" she replied, as she started to rearrange her disheveled hair. "Well, it was worth it, wasn't it?"

"Boss, Ah sees de ladies finally has given in."

"What do you mean, given in?"

"Don't you'all see dat sign, boss? Hit say, 'Ladies Ready-to-Wear Clothes.' "

Aunt Jane: "I want you to promise me never to use two certain words. One is swell and the other lousy. Will you promise?"

Mary Jane: "Sure, Auntie. What are the words?"

Sunday School teacher: "Who gives you your clothing and the food you eat?"

Tommy: "President Roosevelt and Secretary Wallace."

S. S. Teacher: "Who gives you the sun, the stars, and the flowers?"

Tommy: "God."

A little boy sitting next to Tommy, seized his arm and exclaimed: "Sit down, you dirty little Republican!"

HISTORICAL VERSION

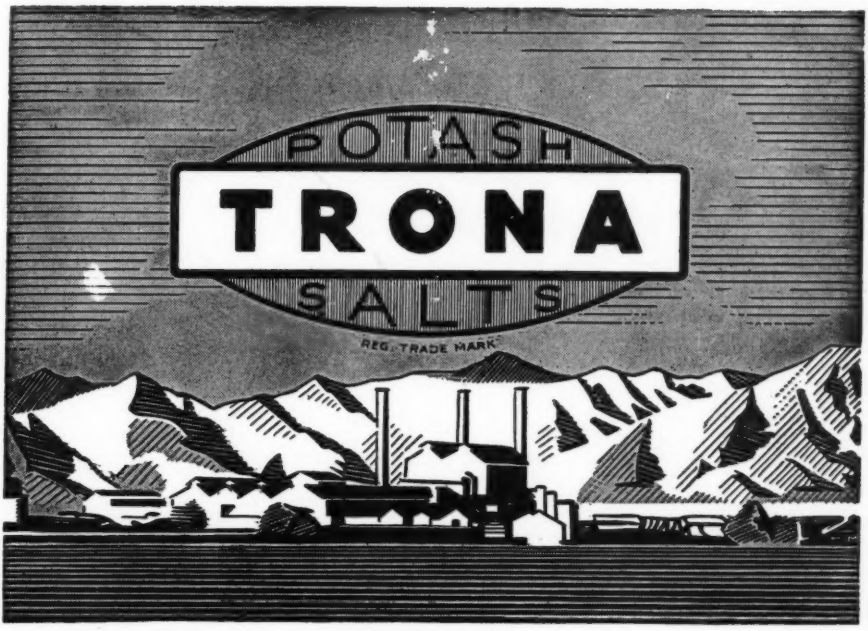
A school boy writing a composition on Queen Elizabeth said: "Elizabeth was a queen and a virgin. As a queen she was a great success."

It was one of mother's busiest days. Her small son, who had been playing outside, came in with his pants torn. His mother helped him change to another pair but in an hour or so he was back, his pants torn again.

"You go right upstairs, remove your pants and mend them yourself," his mother ordered.

Sometime later, she thought of him and went upstairs to see how he was getting on. The torn pants were lying on a chair but there was no sign of Johnnie. Returning downstairs she noticed that the door to the cellar, usually closed, was open, and she called down, loudly and sternly, "Are you running around down there without any pants on?"

A deep voice answered, "No, madam, I'm reading the gas meter."



Trona on Searles Lake, California

TRONA MURIATE of POTASH

"Potash is the *quality* element in the fertilizer mixture. It not only increases yields, but gives to fruits and vegetables the finish and keeping quality which bring best market prices. Potash improves the burning quality of tobacco, and the shape and cooking quality of potatoes. It promotes the growth of clover in pastures, and produces better stands of alfalfa."

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Ewing Galloway

HITCHED TO THE HORIZON

FERTILITY has always been a lodestar to the pioneering urge of the American farmer. Once it hitched his covered wagon to the horizon and sent him forth in search of the elusive land of milk and honey. Today it lures him to the laboratory where Science helps him to find fertile frontiers within his own fields.

The scientist blazes the trail toward a better life. The commercial man widens it into a highway. The fertilizer truck has replaced the prairie schooner. No longer must the farmer search for fertility. It is brought to his fields, scientifically correct and mechanically perfect.

The farmer, the scientist and the fertilizer man have found a land of milk and honey fairer than the fondest dreams of their forefathers. But the pioneering urge is still alive. The horizon is always just ahead. The common goal is a richer life.

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